fectly eaſy in every reſpect: which rule is ſo comprehenſive, that it alſo includes the queſtions of the compound rule, or rule-of-five; and that not only thoſe which are commonly given in books, wherein the ſtatings are either both direct, or one direct and the other inverſe, but alſo thoſe wherein the ſtatings are both indirect.

The fractions are pretty largely treated of; and particulary the abbreviating part; ſince the generality of boys are ſeldom taught them for any other purpoſe but that of abbreviating the operations in all the other rules. The advantage of fractions is ſo great, that I dare affirm it, a perſon who is well acquainted with them, will perform as many calculations as four or five who are not. In decimals the ſeparating points are placed againſt the upper part of the figures; which prevents them from being miſtaken for ſtops or pauſes in the reading; the hint of which I had from ſome tables in Sir *Iſaac Newton*'s optics. And from Mr. *Colſon* I have inſerted a very expeditious method for converting vulgar fractions into decimals conſiſting of many figures.

In compound intereſt, where the time, at which the intereſt is ſuppoſed to be payable, is ſome part of a year, I have, in my calculations, accounted the rate correſponding to that time, the ſame part of the rate for the whole year: thus, at 5 *per cent per annum*, the rate for half-yearly payments I make $2\frac{1}{2}$, and for quarterly payments, $1\frac{1}{4}$, &c. I ſay this here to ſhew upon what ſuppoſition theſe examples are calculated, as it is conteſted whether this method ought to be uſed or not.

In

In the extraction of roots I have given a new, general, and very expeditious method, by which the third and higher roots may be found without any of that intolerable labour attending the common methods.

The proportions are very largely handled, becauſe they are ſo ſlightly treated of in common books, and the rules are expreſſed both algebraically and in words at length. I have alſo inſerted the rules of falſe, becauſe of their great uſe in reſolving many problems, not only in arithmetic, but likewiſe in algebra, geometry, and in ſhort, all the branches of mixt mathematics. For where there is any proportion of the things ſought and thoſe aſſumed to repreſent them, with their ſimilar reſults, there the ſingle rule gives a perfect and the moſt natural ſolution: thus, if it be required to find the ſide of an equilateral triangle whoſe area is 100 ſquare feet; as all equilateral triangles are ſimilar, and ſimilar triangles are as the ſquares of their like, or correſponding ſides, if we aſſume an equilateral triangle whoſe ſide is of any given length, as ſuppoſe of 1 foot, and by any known method calculate its area, which will be $\frac{\sqrt{3}}{4}$; we may hence find the thing required: thus $\frac{\sqrt{3}}{4} : 1^2 :: 100 : \frac{400}{\sqrt{3}}$ the ſquare of the ſide ſought; and therefore, by taking the ſquare root; we have $20 \times 3^{-\frac{1}{4}} =$ the required ſide of the triangle. And in the ſame manner may the reverſe of this problem be performed, *viz.* having given the ſide of a regular figure, to find its area: for,

for, by making the ſame ſuppoſition as before, and inverting the proportion, we ſhall then have the area for the fourth term. Now in this very manner do the writers on menſuration teach us to find the areas of regular figures; and for this purpoſe they take the trouble to form tables of the areas of ſeveral figures whoſe ſides are each equal to 1. And are not all the caſes of trigonometry wrought by the ſame rule? for the writers of it give us large tables containing the parts of all ſorts of right-angled triangles, calculated to a conſtant radius (1); ſo that no triangle can be propoſed, but one ſimilar to it may be there found in known terms; and therefore by forming the homologous parts into a proportion, we arrive at the knowledge of the required parts of the triangle propoſed. —And where we cannot find ſuch proportion as the ſingle rule requires, which happens in many intricate problems in moſt parts of the mathematics, yet there the double rule will approximate to the things required by a very eaſy and quick proceſs: and particularly in exponential equations, ſcarce any method beſide this of *Trial* and *Error* is uſed to find the value of the unknown quantities.

But I have omitted the rule called permutation, as it is of no uſe in common arithmetic, and of but very little in any other part of the mathematics. I have omitted alſo duodecimal arithmetic, as its place is better ſupplied, in all caſes, by the common decimal ſcale of numbers.

To this edition are added the roman notation, a promiſcuous collection of queſtions, and an appendix of retail book-keeping.

CONTENTS.

Double

CONTENTS.

A

COMPLETE SYSTEM

OF

Practical Arithmetic.

PRACTICAL ARITHMETIC is the art of numbering, or of performing calculations by numbers.

NOTATION.

NOTATION is the expressing of any proposed number, either by words, or characters.

All numbers are expressible by these ten characters or figures, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, or cypher: and the usual method of notation by figures is so contrived, that any character is increased in its value in a tenfold proportion for every place it is removed to the left among the other figures with which it is connected; so in these figures 333, the first 3 (reckoning from the right to the left) is 3 ones, but the second is 3 tens, and the third is 3 hundreds; also in these 2759, the 9 represents 9 ones, but the 5 represents 5 tens, the 7 is 7 hundreds, and the 2 is 2 thousand. And though the cypher signify nought of itself, yet when put on the right of any of the other figures, it increaseth their value in the same tenfold proportion above described; thus, though 2 standing alone, or in the first place, represent only 2 ones, yet when a cypher is wrote on the right of it, thus 20, it represents 2 tens or twenty; and if another cypher be affixed, thus 200, it will represent 2 hundreds.

For the more easy reading of large numbers, when they are expressed by figures, they are divided, from the right hand towards the left, into periods and half-periods, each half-period consisting of three figures; the common name of the first period being units or ones; of the second, millions; of the third, billions; of the fourth, trillions,

&c. Alſo the firſt half of any period is ſo many ones of it, but the latter half is ſo many thouſands of it.

The following example exhibits a ſummary of this whole doctrine.

Quintillions	Quadrillions	Trillions	Billions	Millions	Units
th. un.	th. un.	th. un.	th. un.	th. un.	c. x t. c. x. u.
473,829.	759,761.	235,871.	296,473.	913,651.	4 3 7, 2 5 6.

Note, The firſt nine characters are called digits, and ſometimes ſignificant figures, to diſtinguiſh them from the cypher, which of itſelf is inſignificant. Alſo, a number expreſſing a quantity of one name or denomination, is called a ſimple number, as 20 pounds, or 17 gallons, or 5 days; and that repreſenting a quantity of ſeveral names, is called a compound number, as 13 pounds 5 ſhillings and 6 pence, or 17 gallons and two pints, or 3 hours and 50 minutes.

I. *Having any number propoſed in words, to expreſs the ſame in figures.*

RULE.

Write down cyphers to ſo many periods and places as are named in the given number; then beginning at the left, obſerve at each place what ſignificant figure is named, and, taking away the cypher, write the ſignificant figure in its place.

EXAMPLES.

1. Expreſs in figures, Four thouſand, one hundred, and ſeventy-three.

2. Write down in figures, Twenty-three millions, two hundred and ſix thouſand, nine hundred and thirty.

3. Write in figures, Four thouſand and twenty-five millions, one hundred and three thouſand, and ſix.

4. Expreſs in figures, Two hundred ſeventeen thouſand and fifty millions, eight thouſand, ſeven hundred, and ſixteen.

5. Write down in figures, Seventy thouſand billions, one hundred three thouſand and fifty millions, three thouſand and eight.

6. Expreſs in figures, Eight hundred trillions, one hundred ſeventy-five thouſand ſeven hundred and forty-eight billions, three hundred thouſand millions, five thouſand, and ſeventy.

II. *Having any number expreſſed in figures, to read the ſame, or expreſs it in words.*

RULE.

RULE.

Divide the figures in the given number, as in the general example, into periods and half-periods, by any convenient marks; then, beginning at the left, the figures are thus read; *viz.* the first figure of each half-period is named by itself with the word *hundreds*, but the other two are named together; and at the end of the first half of each period, the word *thousands* is named, but at the end of the other half, the common name of the whole period, except it be the units period, whose name is not expressed

EXAMPLES.

1. Let it be required to express in words, 17359.
2. Write down in words, 7301462.
3. Write in words, 3920500706.
4. Express in words, 102003000400.
5. Write in words, 2073000091630702.
6. Write down in words, 5030027869400003.

A SYNOPSIS of the ROMAN NOTATION.

1 = I	
2 = II	As often as any character is repeated, so many times its value is repeated.
3 = III	
4 = IIII or IV	A less character before a greater diminishes its value.
5 = V	
6 = VI	A less character after a greater increases its value.
7 = VII	
8 = VIII	
9 = IX	
10 = X	
50 = L	
100 = C	
500 = D or IↃ:	for every Ↄ affixed, this becomes 10 times so many.
1000 = M or CIↃ:	for every C & Ↄ, put one at each end, it becomes 10 times so much.
2000 = MM	
5000 = IↃↃ or $\overline{V}$	A line over any number, increases it 1000 fold.
6000 = $\overline{VI}$	
10000 = $\overline{X}$ or CCIↃↃ	

50000 = IↃↃↃ
60000 = $\overline{\text{LX}}$
100000 = $\overline{\text{C}}$ or CCCIↃↃↃ
1000000 = $\overline{\text{M}}$ or CCCCIↃↃↃↃ
2000000 = $\overline{\text{MM}}$
&c.

SIMPLE ADDITION.

SIMPLE Addition is the finding of one ſimple number equal to ſeveral ſimple numbers taken all together.

The number which is equal to ſeveral taken together, is called their *ſum.*

Simple Addition may be performed by this

RULE.

1. Place the ſeveral numbers, to be added, underneath each other, ſo that the figures of the ſame name, with reſpect to units, tens, &c. may be ſtrait under each other.

2. Draw a line under the loweſt number, then add up the column of units, and conſider how many tens are in the ſum, for which you muſt carry ſo many ones to the next column, writing down only the exceſs over and above the tens below the line ſtreight under its proper column.

3. Add all the columns in the ſame manner, and the figures below the line will expreſs the ſum required.

There are ſeveral methods uſed to prove addition, but I think that working the queſtion over again is as good as any.

EXAMPLES.

1. What is the ſum of 37, 509, 7126, 17630, and 459273?

2. Required the ſum of 3579, 41, 96120, 725, 11, 1820, 5, and 720139?

3. What is the ſum of 2591, 720396, 14, 259, 6, 370214, 9740, 53, 1692, and 137?

4. How many days are in the twelve calendar months?

5. Sup-

5. Suppoſe that from London to Hatfield is 20 miles, from thence to Stilton 57 miles, thence to Newark 48 miles, thence to Doncaſter 37 miles, thence to Northallerton 62 miles, thence to Durham 34 miles, and from thence to Newcaſtle 15 miles; how many miles are between London and Newcaſtle.

6. A perſon dying, left to his widow 1500 pounds, to his eldeſt ſon he left 30500, and to each of his other two ſons 3456; alſo 2700 to each of his three daughters, beſides 751 pounds in other ſmall legacies; what did he die poſſeſſed of?

SIMPLE SUBTRACTION.

SIMPLE Subtraction is the finding how much one ſimple number exceeds another, or the taking a leſs ſimple number out of a greater.

The number to be ſubtracted is called the *ſubtrahend*, and that out of which it is to be taken is called the *minuend;* alſo the number remaining after the one is taken out of the other, is named their *difference*.

Simple Subtraction is performed by the following

RULE.

1. Place the ſubtrahend under the minuend according to the directions given in addition, and draw a line below them.

2. Begin at the right, and ſubtract each under figure from that which ſtands above it, writing the remainder ſtreight under them below the line; ſo ſhall all the remainders together expreſs the difference required.

3. But when any under figure exceeds that which is above it, conceive 10 to be added to the upper, and ſubtract the under from the ſum; but in this caſe, you muſt add 1 to the next under figure, before you ſubtract it.

To prove Subtraction,

Add the difference and ſubtrahend together, and the ſum will be equal to the minuend when the operation is right.

EXAMPLES.

1. What is the difference between 1735 and 1897348?
2. How much does 510312 exceed 7953?
3. How much is 30491 leſs than 57321469?
4. Suppoſe that from London to Edinburgh (by way of Newcaſtle) is 393 miles, and that from London to Newcaſtle is 273 miles; how many miles are between Newcaſtle and Edinburgh?
5. How much is A older than B, A being born in the year 1701, and B in 1739?
6. How much is C, whoſe age is 71, older than D, whoſe age is 34?

SIMPLE MULTIPLICATION.

SIMPLE Multiplication is the finding of a ſimple number which ſhall contain any given ſimple number a certain propoſed number of times; and is therefore a compendious method of addition.

The two propoſed numbers are, in general, termed the *factors* of the multiplication; but in particular, that which is to be multiplied, is called the *multiplicand*, and that you multiply by, the *multiplier*; alſo the number to be found from the operation is named the *product* of the two factors.

Simple Multiplication may be performed by the two following

RULES.

I. *To multiply by a ſingle figure, or by any number in the firſt line of the following table of products.*

Begin at the right of the multiplicand, and multiply each figure in it by the multiplier, writing down the whole of ſuch products as are leſs than ten; but for ſuch as are juſt equal to a certain number of tens, write down 0, and carry one for each 10 to the next product; and for ſuch as exceed a certain number of tens, write down the exceſs, and carry for the tens as before.

II. *To multiply by a number conſiſting of ſeveral figures.*

1. Write it below the multiplicand, and find the product for each figure in it as in the firſt caſe, not regard-

ing

ing in what order they are found, provided the firſt figure of each ſtand ſtreight below its reſpective multiplier.

2. Add all the lines of products together in the ſame order as they ſtand, and the ſum will be the whole product required.

Multiplication may be proved by caſting out the nines, but the moſt natural and certain way is by diviſion.

TABLE of PRODUCTS.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3		9	12	15	18	21	24	27	30	33	36
4			16	20	24	28	32	36	40	44	48
5				25	30	35	40	45	50	55	60
6					36	42	48	54	60	66	72
7						49	56	63	70	77	84
8							64	72	80	88	96
9								81	90	99	108
10									100	110	120
11										121	132
12											144

EXAMPLES.

1. Multiply 7130492685 by 4.
2. What is the product of 203516748 and 7?
3. What is the product of 15731800296 and 9?
4. What is the product of 58013002716 and 11?
5. What is the product of 932701568 and 12?
6. Required the product of 273580961 and 23.
   Anſwer 6292362103.
7. Required the product of 6241578309 and 37.
   Anſ. 230938397433.
8. What is the product of 5318625074 and 43?
   Anſ. 228700878182.
9. What is the product of 751900368 and 51?
   Anſ. 38346918768.
10. What is the product of 402097316 and 195?
    Anſ. 78408976620.

11. What

11. What is the product of 82164973 and 3027?
Ans. 248713373271.
12. What is the product of 16358724 and 704006?
Ans. 11516639848344.
13. What is the prod. of 921760035 and 520007091?
Ans. 479321754400408185.
14. What is the prod. of 38015732 and 400700065?
Ans. 15232906283422580.

CONTRACTIONS.

I. When there are cyphers at the right of one or both factors, proceed as before, neglecting the cyphers, and to the right of the product, place as many cyphers as are in both factors.

EXAMPLES.

1. Multiply 718603400 by 57. Ans. 40960393800.
2. Required the product of 70100 and 9001635.
Ans. 631014613500.
3. What is the product of 9030100 and 21000?
Ans. 189632100000.
4. What is the product of 7030 and 815036000?
Ans. 5729703080000.

II. So that, if any number is to be multiplied by 1 with cyphers annexed, the product will be equal to the multiplicand with so many cyphers as are in the multiplier.

EXAMPLES.

1. The product of 71 and 10 is 710.
2. The product of 2103 and 100 is
3. The product of 503700 and 1000 is

III. When the multiplier is the product of two or more numbers in the table, it is often of advantage to multiply continually by those numbers instead of it.

EXAMPLES.

1. Required the product of 51307298 and 56, or 7 times 8. Ans. 2873208688.
2. What is the product of 31704592 and 36?
Ans. 1141365312.
3. What is the product of 29753804 and 72?
Ans. 2142273888.

4. What

4. What is the product of 7128368 and 96? Anſ. 684323328.

5. What is the product of 61835720 and 1320? Anſ. 81623150400.

IV. When ſome of the figures of the multiplier may be produced by multiplying ſome others of them by any number, it is much eaſier and more conciſe, after having obtained the product of the leſs, to multiply that product by the ſame number for the product of the greater, than to proceed by the common method.

Note, This holds as well when the leſs numbers are on the left as when they are on the right of the greater; for, by the general rule, the products of the figures of the multiplier may be taken in any order.

1. Multiply 35802916 by 93. Anſ. 3329671188.
2. Required the product of 910738060 and 48. Anſ. 43715426880.
3. What is the product of 61370913 and 96488? Anſ. 5921556653544.
4. What is the product of 13861470 and 52575? Anſ. 728766785250.
5. What is the product of 71380164 and 27354? Anſ. 1952533006056

SIMPLE DIVISION.

SIMPLE Diviſion is the finding how oft one ſimpl enumber is contained in another; or the dividing of any given ſimple number into any propoſed number of equal parts.

The containing number, or number to be divided, is called *dividend.*

The contained number, or the number of parts into which the dividend is divided, is called *diviſor*.

The number of times the dividend contains the diviſor, or the number which expreſſes one of the equal parts, is called *quote* or *quotient:* thus

Dividend

Diviſor 3) 12 (4 Quote

N. B. Diviſion is a compendious ſubtraction, the quote being the number of ſubtractions in the operation.

Simple

Simple Division may be performed by the following

RULE.

1. Having wrote down the divisor and dividend in the form above, consider if the divisor be less than, or equal to, the same number of the left-hand figures of the dividend; if so, write the figure expressing the number of times it is contained in the quote; but if not, take one place more of the dividend figures than are in the divisor, and write the number of times they contain it in the quote as before.

2. Multiply the divisor by the quotient figure.

3. Subtract the product from the said dividend figures.

4. To the remainder affix the next dividend figure, and write in the quote the number of times the divisor is contained in this number; multiply the divisor into the last quotient figure, and subtract the product from the last mentioned number; then proceed as before from the beginning of this article, till all the dividend figures be used.

Note 1. It is sometimes troublesome to find how often the quote is contained in the several dividends; but part of the trouble will be saved by observing, that when any product exceeds its dividual, the quotient figure belonging to such product must be lessened till the product be equal to, or less than its dividual: again, if, after subtracting the product from its dividual, the remainder be equal to, or exceed the divisor; the quotient figure must be increased till the remainder be less than it.

2. To compleat the quote, put the last remainder (if any) at the end of it, above a small line with the divisor below it.

To prove division,

Multiply the quote into the divisor, to the product add the remainder, and the sum will be equal to the dividend when the work is right.

EXAMPLES.

1. Divide 73146085 by 4. —— Ans. 18286521$\frac{1}{4}$.
2. What is the quote of 5317986027 divided by 7?
Ans. 759712289$\frac{4}{7}$.
3. What is the quote of 570196382 by 12?
Ans. 47516365$\frac{2}{12}$.
4. How often is 37 contained in 74638105?
Ans. 2017246$\frac{3}{37}$ times.
5. How often does 137896254 contain 97?
Ans. 1421610$\frac{84}{97}$ times.

6. Di-

6. Divide 35821649 into 764 equal parts.

Anſ. They are each equal $46886\frac{745}{764}$.

7. What is the quote of 72091365 by 5201?

Anſ. $13861\frac{304}{5201}$.

CONTRACTIONS.

I. Diviſion by a ſingle figure, or by any figure in the firſt line of the table of products, may be expeditiouſly perform'd by multiplying and ſubtracting mentally, and writing down only the quote below the dividend.

EXAMPLES.

3) 56103961

Quote $18701320\frac{1}{3}$

4) 52019675

5) 1370192

6) 38172940

7) 81390627

8) 23718620

9) 4308196

10) 7803196

11) 5701423

12) 2798013

II. When the diviſor has cyphers on the right of it, you may ſtrike them off and divide without them; but the ſame number of figures muſt be ſtruck off from the right of the dividend and affixed to the laſt remainder.

EXAMPLES.

2,0) 370419,6

12,00) 718306,15

Di-

Divide 3108690170 by 7100. — Anſ. 437843$\frac{4870}{7100}$.
What is the quote of 7380964 by 23000?
Anſ. 320$\frac{20964}{23000}$.
What is the quote of 2304109 by 5800?
Anſ. 397$\frac{1509}{5800}$.

III. Whence to divide by 1 with any number of cyphers annexed, you need only ſtrike off from the right of the dividend ſo many figures as the diviſor contains cyphers; which figures ſo ſtruck off will be the remainder, and thoſe on the left, the quote.

EXAMPLES.

5138602 divided by 100 is equal 51386$\frac{2}{100}$.
2701483 by 1000 is
3702140 by 100 is

IV. When the diviſor is the product of two or more ſmall numbers, it is much eaſier to divide continually by thoſe numbers than by the whole diviſor at once.

Note, If there be any remainders after ſuch diviſions, multiply the laſt remainder by the preceding diviſor, and to the product add the remainder belonging to the ſame diviſor; then multiply the ſum by the next preceding diviſor, and to the product add its correſponding remainder: proceed in the ſame manner through all the diviſors and remainders, ſo ſhall the laſt ſum be the remainder as if the diviſion had been performed at once.

After the operation deſcribed in this Note is begun, it muſt be continued according to the deſcription, tho' ſome of the preceding diviſions have no remainders.

EXAMPLES.

1. Divide 31046835 by 56, or 7 times 8.
Quote 554407$\frac{43}{56}$.
2. Divide 7014596 by 72. —— Quote 97424$\frac{68}{72}$.
3. Divide 5130652 by 132. — Quote 38868$\frac{76}{132}$.
4. Divide 83016572 by 240. — Quote 345902$\frac{92}{240}$.

V. When you are pretty ready in diviſion, you may, even in the largeſt diviſions, ſubtract each figure of the product as you produce it, and write down only the remainders.

Ex-

EXAMPLES.

1. Divide 3104679 by 833.

833) 3104679 (3727$\frac{88}{833}$.

6056

2257

5919

88

2. Divide 79165238 by 238. — Quote 332627$\frac{12}{238}$.
3. Divide 29137062 by 5317. — Quote 5479$\frac{5219}{5317}$.
4. Divide 62015735 by 7803. — Quote 7947$\frac{5294}{7803}$.

REDUCTION.

REDUCTION is the conversion of numbers from one name to another, but still retaining the same value.

If the reduction be to a less name, it is commonly called reduction *descending*; but if to a greater, reduction *ascending*.

RULE.

Consider how many of the less name concerned make one of the greater, and by that number multiply the given number if the reduction be descending, but divide if ascending, and the product or quote will be of the other name.

Note 1. When there are names between the proposed and required, it is best to reduce the proposed to the next less or greater name, and this to the next less or greater again, and so on, till you have reduced it to the name required.

2. When, in reduction descending, the proposed is a compound number, you must add, or take in the small numbers in the names below the greatest, to the same names as you proceed in the reduction.

3. When, in reduction ascending, you have any remainders after dividing, they will have the same names as their respective dividends, and may be placed after the last quote, according to the order of their names, the greater first; so shall the compound number thus formed be the answer.

Of MONEY.

Farthings	Pence	Shillings	pounds
4	1		
48	12	1	
960	240	20	1

Note 1. This and the following tables are to be underſtood thus: the words at the top are the names of all the numbers ſtreight below them; and all the numbers upon the ſame line, from left to right, are of equal value: thus in the laſt line of this table, 960 farth. 240 pence, 20 ſhill. and 1 pound are all equal to each other.

2. *L* denotes pounds, *s* denotes ſhillings, and *d* denotes pence.

3. $\frac{1}{4}$ denotes 1 farthing, or 1 quarter of any thing.

$\frac{1}{2}$ ——— a half-penny, or a half of any thing.

$\frac{3}{4}$ ——— 3 farthings, or 3 quarters of any thing.

EXAMPLES.

1. How many ſhillings and pence are in 23 *l.*?
Anſ. 460 *s.* 5520 *d.*

2. Reduce 5520 pence to ſhillings and pounds.
Anſ. 460 *s.* 23 *l.*

3. Reduce 351 *l.* 13 *s.* 0$\frac{3}{4}$ *d.* to farthings.
Anſ. 337587 *farthings.*

4. How many pounds, &c. are in 337587 farthings?
Anſ. 351 *l.* 13 *s.* 0$\frac{3}{4}$ *d.*

5. In 35 guineas how many farthings?
Anſ. 35280 *farthings.*

6. In 35280 farthings how many guineas?
Anſ. 35 *guineas.*

7. How many crowns, ſhillings, groats and pence are in 50 pounds? *Anſ.* 200 *cr.* 1000 *s.* 3000 *gr.* 12000 *d.*

8. Reduce 12000 pence to groats, ſhillings, crowns, and pounds. *Anſ.* 3000 *gr.* 1000 *s.* 200 *cr.* 50 *l.*

Of TROY WEIGHT.

Grains	Penny-weights	Ounces	Pound
24	1		
480	20	1	
5760	240	12	1

Note, By this weight are weighed jewels, gold, ſilver, corn, bread, and liquors.

EXAMPLES.

1. How many ounces, pennyweights, and grains are in 37 *lb.* —— *Anſ.* 444 *oz.* 8880 *dwts.* 213120 *grs.*

2. Re-

2. Reduce 213120 grains to *lbs.* —— *Anſ.* 37 *lb.*
3. In 59 *lb.* 13 *dwts.* 5 *grs.* how many grains?
Anſ. 340157 *grs.*
4. In 340157 grains, how many *lbs.* &c.
Anſ. 59 *lb.* 13 *dwts.* 5 *grs.*

Of APOTHECARIES WEIGHT.

Grains	Scruples	Drams	Ounces	Pound
20	1			
60	3	1		
480	24	8	1	
5760	288	96	12	1

Note, This weight is ſo called, becauſe the apothecaries uſe it in compounding their medicines; but they buy and ſell their drugs by avoirdupois weight. Apothecaries is the ſame as troy wt. having only ſome different diviſions.

EXAMPLES.

1 In 17 *lb* how many ounces, drams, and ſcruples?
Anſ. 204 *oz.* 1632 *dr.* 4896 *ſcr.*
2. How many *lbs.* are in 4896 ſcruples?—*Anſ.* 17 *lb.*
3. In 231 *lb.* 3 *oz.* and 5 *grs.* how many grains?
Anſ. 1332005 *grs.*
In 1332005 grains, how many *lb?*
Anſ. 231 *lb.* 3 *oz.* 5 *grs.*

Of AVOIRDUPOIS WEIGHT.

Drams	Ounces	Pounds	Quarters	Hundreds	Ton
16	1				
256	16	1			
7168	448	28	1		
28672	1792	112	4	1	
573440	35840	2240	80	20	1

Note, by this weight are weighed all things of a coarſe or droſſy nature; ſuch as grocery and chandlers wares, and all metals, except gold and ſilver.

EXAMPLES.

1. In 15 tons, how many *c. qrs.* and *lb?*
Anſwer 300 *c.* 1200 *qrs.* 33000 *lb.*
2. Reduce 33600 *lb.* to tons. —— *Anſ.* 15 *tons.*
3. In 9 *c.* 5 *lb.* how many ounces? — *Anſ.* 16208 *oz.*

 4. How

4. How many *c.* are in 16208 *oz?* — *Ans.* 9 *c.* 5 *lb.*

5. In 35 *ton,* 17 *c.* 1 *qr.* 23 *lb.* 7 *oz.* 13 *dr.* how many drams? — — — *Ans.* 20571005 *dr.*

6. Reduce 20571005 drams to tons.

Ans. 35 *t.* 17 *c.* 1 *qr.* 23 *lb.* 7 *oz.* 13 *dr.*

Of LONG MEASURE.

Inches	Feet				
12	1	Yards			
36	3	1	Poles		
198	16½	5½	1	Furlongs	
7920	660	220	40	1	Mile
63360	5280	1760	320	8	1

Note, An inch is supposed equal to 3 barley corns in length.

4 inch.——a hand.

6 feet——a fathom

3 miles——a league.

60 nautical or geographical miles——a degree, or 69½ statute miles nearly.

Also 360 degrees, or 25000 miles nearly, is the circumference of the earth.

EXAMPLES.

1. How many inches are between London and Newcastle, or in 273 miles? —— *Ans.* 17297280 *inch.*

2. In 17297280 inches, how many miles?

Ans. 273 *miles.*

3. Reduce 15 *mls.* 1 *furl.* 3 *yds.* into inches.

Ans. 364428 *inch.*

4. In 364428 inches, how many miles?

Ans. 15 *mls.* 1 *fur.* 3 *yds.*

5. Reduce 2 *mls.* 1 *furl.* 8 *pls.* 3 *yds.* 2 *inc.* into inches.

Ans. 136334 *inch.*

6. In 136334 inches, how many miles, *&c?*

Ans. 2 *mls* 1 *furl* 8 *pls.* 3 *yds.* 2 *inch.*

Of CLOTH MEASURE.

Inches	Nails		
2	1	Quarters	
9	4	1	Yard
36	16	4	1

Note,

Note, 3 qrs. are equal to an ell flemish.
5 — — english.
6 — — french.
4 qrs. $1\frac{1}{5}$ inch. — scots.

EXAMPLES.

1. In 37 *yds*. how many *qrs*. and nails?
Ans. 148 *qrs*. 592 *nails*.
2. How many *yds*. are in 592 nails? — *Ans*. 37 *yds*.
3. Reduce 15 *yds*. 3 *qrs*. 1 *nl*. to nails. *Ans*. 253 *nails*.
4. How many *yds*. are in 253 nails?
Ans. 15 *yds*. 3 *qrs*. 1 *nl*.
5. In 73 ells flemish, how many *qrs*?—*Ans*. 219 *qrs*.
6. How many ells flem. are in 219 *qrs*?
Ans. 73 *ells flem*.
7. Reduce 17 *ells eng*. 3 *qr*. to nails.—*Ans*. 352 *nails*.
8. In 352 nails, how many *ells eng*.?
Ans. 17 *el. eng*. 3 *qr*.

Of SQUARE, *or* LAND MEASURE.

Square inch.	Sqr. feet				
144	1	Sqr yds.			
1296	9	1	Sqr. poles		
39204	$272\frac{1}{4}$	$30\frac{1}{4}$	1	Roods	
1568160	10890	1210	40	1	Acre
6272640	43560	4840	160	4	1

EXAMPLES.

1. In 15 Acres, how many poles. — *Ans*. 2400 *poles*.
2. How many acres are in 2400 poles?—*Ans*. 15 *acres*.
3. Reduce 27 *a*. 1 *r*. 32 *p*. into poles —*Ans*. 4392 *poles*.
4. Reduce 4392 poles into acres.—*Ans* 27 *a*. 1 *r*. 32 *p*.

Of WINE MEASURE.

Pints	Gallons					
8	1	Tierces				
336	42	1	Hhds.			
504	63	$1\frac{1}{2}$	1	Punch.		
672	84	2	$1\frac{1}{3}$	1	Pip. or But	
1008	126	3	2	$1\frac{1}{2}$	1	Tun
2016	252	6	4	3	2	1

Note, 231 solid inch.—a gallon.
10 gall.—an anchor.
18 gall.—a rundlet.
$31\frac{1}{2}$ gall.—a barrel.

By this measure, wines, brandies, spirits, perry, cyder, mead, vinegar, oil, and honey are measured.

EXAMPLES.

1. In 19 *hhds.* of wine, how many pints? *Ans.* 9576 *pints.*
2. How many *hhds.* are in 9576 pints of wine? *Ans.* 19 *hds.*
3. Reduce 13 *tuns,* 1 *pipe,* 1 *hhd.* 17 *gall.* 5 *pts.* to pints. *Ans.* 27861 *pints.*
4. Reduce 27861 pints to tuns. *Ans.* 13 *tuns,* 1 *pipe,* 1 *hhd.* 17 *gall.* 5 *pints.*

Of ALE *and* BEER MEASURE.

Pints	Gall.	Firk.	Kilderk.	Bar.	Hhds
8	1				
68	$8\frac{1}{2}$	1			
136	17	2	1		
272	34	4	2	1	
408	51	6	3	$1\frac{1}{2}$	1

Note, The ale gallon contains 282 cubic inches.

In London, the ale firkin, contains 8 gal. and the beer firkin 9; the other measures above it being decreased and increased in the same proportion.

EXAMPLES.

1. In 13 *hhds.* of ale, how many gallons?—*Ans.* 663 *gall.*
2. How many *hhds.* are in 663 gallons of ale? *Ans.* 13 *hhds.*
3. How many pints are in 1 *bar.* 1 *fir.* 3 *pts.* of ale? *Ans.* 343 *pints.*
4. Reduce 343 pints of ale to barrels. *Ans.* 1 *bar.* 1 *fir.* 3 *pts.*

Of DRY MEASURE.

Pints	Gall.	Pecks	Bush.	Combs	Quar.	Weys	Last
8	1						
16	2	1					
64	8	4	1				
256	32	16	4	1			
512	64	32	8	2	1		
2560	320	160	40	10	5	1	
5120	640	320	80	20	10	2	1

Note,

Note, The gall. dry measure, contains 268$\frac{4}{5}$ cubic inches. At London, 36 bushels of coals make a chaldron. A bushel water measure is 5 pecks.

By this measure, all dry wares, such as corn, seeds, fruits, roots, sand, salt, coals, oisters, muscles, cockles, &c. are measured.

EXAMPLES.

1. In 128 *qrs.* how many pecks? — *Ans.* 4096 *pecks.*
2. How many *qrs.* are in 4096 pecks?—*Ans.* 128 *qrs.*
3. In 3 *lasts*, 5 *qrs.* 3 *bush.* how many gallons?
Ans. 2264 *gal.*
4. Reduce 2264 gallons to lasts. *Ans.* 3 *gls.* 5 *qr.* 3 *bush.*

Of TIME.

Minutes	Hours			
60	1	Days		
1440	24	1	Weeks	
10080	168	7	1	Month
40320	672	28	4	1

Note, The minute is divided into 60 seconds, and the second may be supposed to be divided into 60 thirds, and these again into 60 fourths, *&c.*

EXAMPLES.

1 How many minutes are in 1763 months?
Ans. 71084160 *min.*

2 In 71084160 minutes, how many months?
Ans. 1763.

3. How many seconds are in a solar year, or 365 *ds.* 5 *hrs.* 48 *min.* 58 *sec.*? — — *Ans.* 31556938 *sec.*

4. In 31556938 seconds, how many days, *&c.*?
Ans. 365 *ds.* 5 *hrs.* 48 *min.* 58 *sec.*

5. In a lunar month, or 29 *ds.* 12 *hrs.* 45 *min.* how many seconds? — — — *Ans.* 2551500 *sec.*

6. Reduce 2551500 seconds to days.
Ans. 29 *ds.* 12 *hrs.* 45 *min.*

COMPOUND ADDITION.

COMPOUND Addition is the finding of the sum of several compound numbers.

RULE.

1. Place the numbers of the same denomination under each other according to the directions given in simple addition.

2. Add

2. Add up the figures in the loweſt denomination as in ſimple addition.

3. Find how many ones of the next higher denomination are contained in the ſum, by dividing it by ſo many as of this name make one of the next, or any other way.

4. Write the remainder or overplus underneath, and carry the ones to the figures in the next denomination, whoſe ſum you muſt find and proceed with as before; and ſo on, through all the denominations to the higheſt, whoſe ſum muſt be all wrote down, which, together with the ſeveral remainders, will expreſs the ſum required.

Note, Addition of money may be performed by the general rule, or by the help of the following

PENCE TABLES.

d.		s.	d.	s.		d.
20	——	1	8	2	——	24
30	——	2	6	3	——	36
40	——	3	4	4	——	48
50	——	4	2	5	——	60
60	——	5	-	6	——	72
70	——	5	10	7	——	84
80	——	6	8	8	——	96
90	——	7	6	9	——	108
100	——	8	4	10	——	120
110	——	9	2	11	——	132
120	——	10	-	12	——	144

EXAMPLES of MONEY.

l.	s.	d.	l.	s.	d.	l.	s.	d.	l.	s.	d.
7	13	3	14	7	5	15	17	10	53	14	8
3	5	10½	8	19	2¼	3	14	6	5	10	2¾
6	18	7	5	3	4½	23	6	2¾	93	11	6
-	2	5¾	21	2	9	8	3	5	7	5	-
4	-	3	7	16	8½	15	6	4	2	-	9
17	15	4½	-	4	3	6	12	9¼	-	18	7

l.	*s.*	*d.*	*l.*	*s.*	*d.*	*l.*	*s.*	*d.*	*l.*	*s.*	*d.*
14	9	$7\frac{1}{4}$	37	15	8	61	3	$2\frac{1}{2}$	472	15	3
5	13	6	14	12	$9\frac{1}{4}$	7	16	8	9	2	$2\frac{1}{2}$
62	4	7	5	6	11	29	13	$10\frac{3}{4}$	27	12	$6\frac{1}{4}$
4	17	8	23	10	$9\frac{1}{4}$	8	14	-	370	16	$2\frac{1}{2}$
23	-	$4\frac{3}{4}$	8	6	-	-	7	$5\frac{1}{4}$	25	3	8
6	6	7	14	-	$5\frac{1}{2}$	24	13	-	6	10	$5\frac{3}{4}$
91	-	$10\frac{1}{4}$	54	2	$7\frac{1}{2}$	5	-	$10\frac{3}{4}$	30	-	$11\frac{3}{4}$

Suppoſe that *A* is indebted to *B*, 34*l* 13*s.* 7*d.* to *C*, 1730*l.* to *D*, 9*l.* 19*s.* 2*d.* to *E*, 134*l.* 7*d.* to *F*, 17*s.* 2*d.* and to *G*, 9*d.* what is *A*'s whole debt?

Anſ. 1909*l* 11*s.* 3*d.*

Suppoſe that *B* owes *A* 75*l.* 17*s.* *C* owes 15*s.* 5*d.* *D* owes 21*l.* 13*s.* $6\frac{1}{2}$*d.* *E* owes $9\frac{1}{2}$*d.* *F* owes 796*l.* 3*d.* and *G* owes 17*l.* 13*s.* 10*d.* What is due to *A* by all of them? —— —— *Anſ.* 912*l.* 10*d.*

A owes to *B*, for tea, 13*l.* 10*s.* for cheeſes, 17*l* 13*s.* 5*d.* for cotton, 208*l.* 17*s.* for indian chints, 86*l.* 7*d.* for his acceptance of a bill, 300*l.* for factorage, 15*l.* 17*s.* $3\frac{1}{4}$*d.* alſo for inſurance and other charges, 30*l.* 10*s.* $4\frac{1}{2}$*d.* How much is *A*'s whole debt to *B*?

Anſ. 672*l.* 8*s.* $8\frac{1}{4}$*d.*

A corn-factor pays, for wheat, 37*l.* 15*s.* 8*d.* for rye, 11*l.* 16*s.* 3*d.* for oats, 96*l.* $7\frac{1}{2}$*d.* for barley, 53*l.* 12*s.* alſo for peas and beans, 10*l.* he has alſo paid for carriage and other petty charges, 3*l.* 17*s.* $5\frac{3}{4}$*d.* and for inſurance, 11*l.* $3\frac{1}{4}$*d.* now ſuppoſe that his commiſſion on the whole is 7*l* 3*s.* $0\frac{1}{2}$*d.* for how much muſt he draw upon his employer to clear the account? — 231*l.* 5*s.* $4\frac{1}{2}$*d.*

A nobleman, going out of town, is informed by his ſteward, that his butcher's bill comes to 197*l.* 13*s.* $7\frac{1}{2}$*d.* his baker's to 59*l.* 5*s.* $2\frac{1}{4}$*d.* his brewer's to 85*l.* his wine-merchant's to 103*l.* 13*s.* to his lordſhip's corn-chandler is due 75*l.* 3*d.* to his tallow-chandler and cheeſe-monger, 27*l.* 15*s* $11\frac{1}{4}$*d.* and to his taylor, 55*l.* 3*s.* $5\frac{1}{4}$*d.* alſo for rent, ſervants wages, and other charges, 127*l.*

127 *l.* 3 *s.* Now ſuppoſing he would take 100 *l.* with him to defray his charges on the road, for what ſum muſt he ſend to his banker? —— *Anſ.* 830 *l.* 14 *s.* 6¼ *d.*

EXAMPLES of WEIGHTS, MEASURES, &c.

Troy Weight

lb.	*oz.*	*dwt*	*oz*	*dwt.*	*gr.*
17	3	15	37	9	3
4	6	3	9	5	13
-	10	7	3	16	21
9	5	-	17	7	8
176	2	17	5	9	-
23	11	12	3	-	19

Apothecaries Weight

lb.	*oz.*	*dr.*	*ſc.*	*oz*	*dr.*	*ſc.*	*gr.*
3	5	7	2	3	5	1	17
13	7	3	-	7	3	2	5
9	11	-	1	16	7	-	12
-	9	1	2	9	5	1	5
36	3	5	-	4	1	2	18
5	8	6	1	36	4	1	14

Avoirdupois Weight

lb.	*oz.*	*dr.*	*cwt.*	*qr.*	*lb.*
17	10	13	15	2	15
5	14	8	6	3	24
8	6	15	7	-	10
27	1	9	26	1	17
-	4	-	10	2	6
6	14	10	3	-	3

Long Meaſure

mls.	*fur.*	*pls.*	*yds.*	*feet*	*inc.*
29	3	14	127	1	5
18	6	29	12	2	9
5	4	20	-	2	6
9	1	37	54	1	11
7	-	3	5	2	7
4	5	9	23	-	5

Cloth Meaſure

yds.	*qr.*	*nls.*	*el. en.*	*qr.*	*nls.*
26	3	1	270	1	-
13	1	2	57	4	3
6	2	-	8	2	1
217	-	3	-	3	2
9	1	-	10	1	-
55	3	1	4	4	1

Land Meaſure

ac.	*ro.*	*p.*	*ac.*	*ro.*	*p.*
225	3	37	19	-	16
16	1	25	270	3	29
9	-	13	9	1	3
4	2	9	23	-	34
42	1	19	7	2	16
7	-	6	75	1	23

Wine Measure

T.	*hds.*	*gal.*	*hds.*	*gal.*	*pts.*
13	3	15	15	61	5
8	1	37	7	16	3
4	2	26	29	23	7
25	-	12	3	15	1
3	1	9	16	8	-
72	3	21	4	36	6

Ale and *Beer Measure*

hds.	*gal.*	*pts.*	*hds.*	*gal.*	*pts.*
17	37	3	29	43	5
4	13	5	7	9	2
3	6	2	14	16	6
5	14	-	6	8	1
12	9	6	57	13	4
8	42	4	5	6	-

Dry Measure

L.	*qr.*	*bu.*	*qr.*	*bu.*	*pe.*
13	5	2	25	7	3
7	1	3	5	3	1
41	7	4	17	5	2
3	-	7	6	2	-
24	3	-	33	-	2
5	2	1	7	4	1

Time

mo.	*we.*	*da.*	*hrs.*	*m.*	*s.*
17	3	4	27	15	37
26	1	6	12	26	14
7	-	2	3	7	16
19	2	3	35	42	59
8	3	-	6	9	4
12	1	6	31	16	32

A gentleman bought of a ſilver-ſmith, diſhes to the weight of 23 *lb.* 6 *oz.* 5 *dwt.* plates, 41 *lb.* 7 *oz* 17 *dwt.* ſpoons, 12 *lb.* 15 *dwt.* ſalts, 2 *lb.* 7 *oz.* preſenters, 13 *lb.* and tankards, 7 *lb.* 17 *dwt.* What weight of plate did he buy in all? — — *Anſ.* 99 *lb.* 10 *oz.* 14 *dwt.*

An apothecary made a compoſition of 5 ingredients, the 1ſt of which weigh'd 13 *lb.* 7 *oz.* the 2d, 11 *oz.* 7 *dr.* 13 *gr.* the 3d, 7 *lb.* 2 *ſcr.* the 4th, 11 *lb.* 3 *dr.* 1 *ſcr.* and the 5th weigh'd 15 *lb.* 5 *oz.* 7 *gr.* What was the weight of the whole? — — *Anſ.* 48 *lb.* 3 *dr.* 1 *ſc.*

A country ſhop-keeper buys of a merchant in London, teas, weighing 3 *qrs.* 14 *lb.* Coffee, 1 *qr.* 23 *lb.* ſugars, 3 *cwt.* 2 *qr.* 5 *lb.* ſpices, 2 *qr.* 3 *lb.* 13 *oz.* hops, 13 *cwt.* 1 *qr.* 24 *lb.* and ſeveral other things to the weight of 3 *cwt.* 17 *lb.*

17 *lb.* 7 *oz.* For what weight has he to pay carriage on bringing them home? — *Anſ.* 22 *cwt.* 3 *lb.* 4 *oz.*

From *A* to *B* is 3 *mls.* 2 *fur.* 7 *pls.* from *B* to *C* is 17 *mls.* 13 *pls.* from *C* to *D* is 7 *fur.* and from *D* to *E* is 5 *mls.* 33 *pls.* What is the diſtance between *A* and *E*?

Anſ. 26 *mls.* 2 *fur.* 13 *pls.*

Bought four parcels of cloth, the 1*ſt* of which contains 25 *yds.* 3 *qr.* the 2*d*, 37 *yds.* 2 *qr.* 3 *nls.* the 3*d*, 14 *yds.* 1 *n.* and the 4*th*, 23 *yds.* How many yards are in them all? — — — *Anſ.* 100 *yds.* 2 *qrs.*

There are five pieces of ground, the firſt of which meaſures 13 *ac.* 3 *r.* 14 *p.* the ſecond, 27 *ac.* 29 *p.* the third, 19 *ac.* 1 *r.* the fourth, 3 *r.* 34 *p.* and the fifth, 45 *ac.* 2 *r.* 11 *p.* What is the ſum of their meaſures?

Anſ. 160 *ac.* 3 *r.* 9 *p.*

A gentleman bought of a wine-merchant, of port wine, 1 *tun*, 3 *hhds.* of claret, 3 *hhds.* 47 *gal.* of mountain, 1 *hhd.* 5 *gal.* and of Liſbon, 2 *hhds.* 23 *gal.* What quantity did he buy in all? — — *Anſ.* 3 *tn.* 2 *hhd.* 12 *gal.*

A beer-brewer has ſent into the country, ale as follows, *viz.* at one time, 3 *hhds.* 14 *gal.* at another, 2 *hhds.* 17 *gal.* at another, 14 *hhds.* 27 *gal.* and at another, 5 *hhds.* 47 *gal.* How much was ſent at all the times?

Anſ. 26 *hhds.* 3 *gal.*

A corn-merchant ſends over the ſea, of wheat, 13 *laſts*, 3 *qr.* 5 *buſh.* of oats, 29 *lſts.* 7 *qr.* of rye, he has ſent 3 *lſts.* 7 *buſh.* of peas, 8 *qrs.* 3 *buſh.* and of beans, 5 *qr.* For what has he freight to pay?

Anſ. 47 *lſts.* 4 *qr.* 7 *buſh.*

When *B* was born, *A*'s age was 113 *mths.* 2 *wks.* when *C* was born, *B*'s age was 97 *mo.* 1 *we.* 5 *ds.* when *D* was born, *C*'s age was 107 *mo.* 3 *ds.* 14 *hrs.* and when *E* was born, *D*'s age was 75 *mo.* 3 *we.* 19 *hrs.* What was *A*'s age when *E* was born?

Anſ. 393 *mo.* 3 *we.* 2 *ds.* 9 *hrs.*

COM-

COMPOUND SUBTRACTION.

COMPOUND Subtraction is the finding of the difference of two numbers, whereof one or both are compound.

RULE.

1. Write the less number under the greater, as directed in compound addition.

2. Then, beginning at the least denomination, subtract the under number of each from the upper, writing their respective remainders below them.

3. But if the under number of any of the denominations be greater than the upper, add so many to the upper as make one of the next higher denomination; then take the under from the sum, writing down the remainder as before, and carry or add one to the under number of the next higher denomination before you subtract it.

EXAMPLES of MONEY.

	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
From	79	17	8¼	103	3	2½	57	—	10	251	13	—
Take	35	12	4¼	71	12	5¾	29	13	3¾	35	4	7¾
Rem.												
Proof												

What is the difference between 73*l.* 5¼*d.* and 19*l.* 13*s.* 10*d?* — — — *Anf.* 53*l.* 6*s.* 7¼*d.*

A lends to *B* 100*l.* how much is *B* in his debt, after *A* has taken goods of him to the amount of 73*l.* 12*s.* 4¾*d.* — — — *Anf.* 26*l.* 7. 7¼*d.*

Suppose that my rent for half a year is 10*l.* 12*s.* and that I have laid out for the land tax, 14*s.* 6*d.* and for several repairs, 1*l.* 3*s.* 3¼*d.* what have I to pay of my half year's rent? — — *Anf.* 8*l.* 14*s.* 2¾*d.*

A trader failing, owes to *A*, 35*l.* 7*s.* 9*d.* to *B*, 91*l.* 13*s.* ½*d.* to *C*, 53*l.* 7½*d.* to *D*, 87*l.* 5*s.* and to *E*,

 118*l.*

111 *l.* 3 *s.* $5\frac{3}{4}$ *d.* When this happened, he had by him in cash, 23 *l.* 7 *s.* 5 *d.* in wares, 53 *l.* 11 *s.* $10\frac{1}{4}$ *d.* in household furniture, 63 *l.* 17 *s.* $7\frac{3}{4}$ *d.* and in recoverable book-debts, 25 *l.* 7 *s.* 5 *d.* What will his creditors lose by him, supposing these things delivered to them?

Ans. 212 *l.* 5 *s.* $6\frac{1}{2}$ *d.*

EXAMPLES of WEIGHTS, MEASURES, &c.

Troy Weight.

	lb.	oz.	dwt.	gr.	lb.	oz.	dwt.	gr.
From	7	3	14	11	4	9	1	23
Take	3	7	5	19	3	7	16	12
Rem.								
Proof								

Apothecaries Weight.

	lb.	oz.	dr.	scr.	gr.
From	73	4	7	—	14
Take	26	7	2	1	16
Rem.					
Proof					

Avoirdupois Weight.

	C.	qr.	lb.	lb.	oz.	dr.
From	5	—	17	71	5	9
Take	3	2	11	14	6	14
Rem.						
Proof						

Long Measure.

	M.	fu.	pl.	yd.	ft.	in.
From	14	3	17	96	1	4
Take	3	7	9	41	2	7
Rem.						
Proof						

Cloth Measure.

	yd.	qr.	nl.	yd.	qr.	nl.
From	17	2	1	9	—	2
Take	5	2	3	6	1	2
Rem.						
Proof						

Land Measure.

	ac.	ro.	p.	ac.	ro.	p.
From	17	1	14	57	1	16
Take	9	3	6	24	2	25
Rem.						
Proof						

Wine

	Wine Measure.						*Ale and Beer Measure.*					
	T.	*hd.*	*gal.*	*hd.*	*gal.*	*pt.*	*hd.*	*gal.*	*pt.*	*hd.*	*gal.*	*pt.*
From	17	2	23	5	—	4	14	29	3	71	16	5
Take	4	3	39	3	2	7	7	34	5	17	3	2
Rem.												
Proof												

	Dry Measure.						*Time.*					
	la.	*qr.*	*bu.*	*bu.*	*gal.*	*pt.*	*mo.*	*we.*	*da.*	*ds.*	*hrs.*	*min.*
From	9	4	7	13	7	1	71	2	5	114	17	26
Take	3	7	2	7	3	4	14	3	—	75	12	33
Rem.												
Proof												

COMPOUND MULTIPLICATION.

COMPOUND Multiplication is the finding of a number which ſhall contain a given compound number any propoſed number of times.

RULE.

1. Write the multiplier under the loweſt denomination of the multiplicand.

2. Multiply the number of the loweſt denomination by the multiplier, and find how many ones of the next higher denomination are contained in the product, as in compound addition.

3. Write down the exceſs, and carry the ones to the product of the next higher denomination, with which proceed as before; and in like manner with all the other denominations to the higheſt.

I. EXAMPLES of MONEY.

3 *lb.* of green tea, at 9 *s.* 6 *d. per lb.* *Anſ.* 1 *l.* 8 *s.* 6 *d.*

5 *lb.* of ſugar, at 1 *s.* 3 *d.* *Anſ.* 6 *s.* 3 *d.*

7 *lb.* of tobacco, at 1 *s.* 8½ *d.* — *Anſ.* 11 *s.* 11½ *d.*

9 *lb.* of galls, at 1 *s.* 5 *d.* *Anſ.* 12 *s.* 9 *d.*

11 *cwt.* of cheeſe, at 1 *l.* 15 *s.* 6 *d.* *Anſ.* 19 *l.* 10 *s.* 6 *d.*

4 *lb.* of bohea tea, at 7 *s.* 8 *d.* — *Anſ.* 1 *l.* 10 *s.* 8 *d.*

6 *lb.* of flax, at 9½ *d.* *Anſ.* 4 *s.* 9 *d.*

8 *ſtones* of beef, at 2 *s.* 7½ *d.* — *Anſ.* 1 *l.* 1 *s.*

10 *cwt.* of cheeſe, at 2 *l.* 17 *s.* 10 *d.* *Anſ.* 28 *l.* 18 *s.* 4 *d.*

12 *cwt.* of ſugar, at 3 *l.* 7 *s.* 4 *d.* — *Anſ.* 40 *l.* 8 *s.*

If the multiplier exceed 12, it is commonly beſt to multiply ſucceſſively by its component parts, as in ſimple multiplication.

EXAMPLES.

14 moidores, at 1 *l.* 7 *s.* *Anſ.* 18 *l.* 18 *s.*

16 *cwt.* of cheeſe, at 1 *l.* 18 *s.* 8 *d.* *Anſ.* 30 *l.* 18 *s.* 8 *d.*

20 *cwt.* of hops, at 4 *l.* 7 *s.* 2 *d.* — *Anſ.* 87 *l.* 3 *s.* 4 *d.*

22 tons of hay, at 1 *l.* 2 *s.* *Anſ.* 24 *l.* 4 *s.*

25 *yds.* of broad cloth, at 9 *s.* 2 *d.* — *Anſ.* 11 *l.* 9 *s.* 2 *d.*

28 *yds.* ſuperfine broad cloth, at 19 *s.* 4 *d.* *Anſ.* 27 *l.* 1 *s.* 4 *d.*

32 *yds.* german ſerge, at 3 *s.* 7 *d.* — *Anſ.* 5 *l.* 14 *s.* 8 *d.*

35 *yds.* iriſh cloth, at 2 *s.* 5½ *d.* — *Anſ.* 4 *l.* 6 *s.* ½ *d.*

40 ells of holland, at 5 *s.* 6 *d.* — — *Anſ.* 11 *l.*

15 piſtoles, at 17 *s.* 6 *d.* *Anſ.* 13 *l.* 2 *s.* 6 *d.*

18 *cwt.* of tobacco, at 5 *l.* 11 *s.* 4 *d.* *Anſ.* 100 *l.* 4 *s.*

21 *cwt.* of hemp, at 1 *l.* 12 *s.* — *Anſ.* 33 *l.* 12 *s.*

24 tons of hay, at 3 *l.* 7 *s.* 6 *d.* — *Anſ.* 81 *l.*

27 *yds.* of fine broad cloth, at 15 *s.* 7 *d.* *Anſ.* 21 *l.* 9 *d.*

30 *yds* of ſhalloon, at 2 *s.* 2½ *d.* — *Anſ.* 3 *l.* 6 *s.* 3 *d.*

33 *yds.* of flannel, at 1 *s.* 3 *d.* — *Anſ.* 2 *l.* 1 *s.* 3 *d.*

36 *yds.* of ſcotch cloth, at 2 *s.* 9 *d.* — *Anſ.* 4 *l.* 19 *s.*

42 ells of holland, at 6 *s.* 9½ *d.* — *Anſ.* 14 *l.* 5 *s.* 3 *d.*

64 gal-

44 ells of dowlas, at 1*s.* 4*d.* — *Anſ.* 2*l.* 18*s.* 8*d.*

48 *ac.* of arable ground, at 2*l.* 3*s.*—*Anſ.* 103*l.* 4*s.*

50 *ac.* paſture ground, at 1*l.* 4*s.* 6*d.* *Anſ.* 61*l.* 5*s.*

55 tuns of wine, at 83*l.* 10*s.* — *Anſ.* 4592*l.* 10*s.*

60 gallons of wine, at 5*s.* 8*d.* — *Anſ.* 17*l.*

64 gallons of brandy, at 9*s.* 6*d.* — *Anſ.* 30*l.* 8*s.*

70 barrels of ale, at 1*l.* 4*s.* — — *Anſ.* 84*l.*

77 firkins of beer, at 11*s.* 7*d.* *Anſ.* 44*l* 11*s.* 11*d.*

81 firkins of ſoap, at 1*l.* 8*s.* 9*d.*—*Anſ.* 116*l.* 8*s.* 9*d.*

88 *qrs.* of oats, at 11*s.* 6*d.* — *Anſ.* 50*l.* 12*s.*

96 *qrs.* of rye, at 1*l.* 3*s.* 4*d.* — — *Anſ.* 112*l.*

100 ſtones of wool, at 7*s.* 3*d.* — *Anſ.* 36*l.* 5*s.*

120 *doz.* candles, at 5*s.* 9*d.* — *Anſ.* 34*l.* 10*s.*

132 days wages, at 2*s.* 4*d.* — *Anſ.* 15*l.* 8*s.*

45 ells of dowlas, at 1*s.* 6*d.* — *Anſ.* 3*l.* 7*s.* 6*d.*

49 *acr.* meadow, at 1*l.* 7*s.* 10.—*Anſ.* 68*l.* 3*s.* 10*d.*

54 *acr.* land, at 1*l.* 13*s.* *Anſ.* 89*l.* 2*s.*

56 pipes of wine, at 37*l.* 7*s.* 6*d.* — *Anſ.* 2093*l.*

63 *gall.* of oil, at 2*s.* 3*d.* *Anſ.* 7*l.* 1*s.* 9*d.*

66 *gall.* of rum, at 8*s.* 10*d.* — *Anſ.* 29*l.* 3*s.*

72 *hds.* at 1*l.* 14*s.* 4*d.* *Anſ.* 123*l.* 12*s.*

80 firkins of butter, at 1*l.* 5*s.* 6*d.* — *Anſ.* 102*l.*

84 *qrs.* of wheat, at 1*l.* 12*s.* 8*d.* — *Anſ.* 137*l.* 4*s.*

90 *qrs.* of barley, at 17*s.* 10*d.* — *Anſ.* 80*l.* 5*s.*

99 buſhels of malt, at 6*s.* $3\frac{1}{2}$*d.* *Anſ.* 31*l.* 2*s.* $10\frac{1}{2}$*d.*

110 ſheep, at 12*s.* 8*d.* *Anſ.* 69*l.* 13*s.* 4*d.*

121 weeks wages, at 7*s.* 6*d.* — *Anſ.* 45*l.* 7*s.* 6*d.*

144 reams of paper, at 13*s.* 4*d.* — *Anſ.* 96*l.*

† Note, The following examples require the continual product of three numbers.

112 *lb.* or 1 *cwt.* at 3*s.* $4\frac{1}{2}$*d.* *per lb.*—*Anſ.* 18*l.* 18*s.*

224 *lb.* or 2 *cwt.* at 7*s.* $3\frac{1}{4}$*d.* *per lb.* *Anſ.* 81*l.* 8*s.* 8*d.*

336, at 1*s.* 5*d.* each. *Anſ.* 23*l.* 16*s.*

1 *cwt.* at 1*s.* 9*d.* *per lb.* *Anſ.* 9 *l.* 16*s.*

336 *lb.* or 3 *cwt.* at 5*s.* $2\frac{1}{4}$*d.* *per lb.* *Anſ.* 87*l.* 17*s.*

350, at 3*s.* $2\frac{1}{4}$*d.* each. *Anſ.* 55*l.* 15*s.* $7\frac{1}{2}$*d.*

But if the multiplier cannot be produced by the multiplication of small numbers, find the nearest to it, either greater or less, which can be so produced; then after having multiplied continually by the component parts of this number, to or from the last product, add or subtract the produce of so many as it is less, or greater than the given number.

EXAMPLES.

17 at 5s. 6d.
Ans. 4l. 13s. 6d.

23 at 1s. 6$\frac{1}{2}$d.
Ans. 1l. 15s. 5$\frac{1}{2}$d.

29 at 2l. 5s. 3$\frac{1}{4}$d.
Ans. 65l. 12s. 10$\frac{1}{4}$d.

34 at 19s. 7d.
Ans. 33l. 5s. 10d.

38 at 1l. 11s. 5$\frac{1}{2}$d.
Ans. 59l. 15s. 5d.

41 at 3s. 1d.
Ans. 6l. 6s. 5d.

46 at 4s. 7$\frac{1}{4}$d.
Ans. 10l. 11s. 9$\frac{1}{2}$d.

51 at 6s. 7$\frac{1}{4}$d.
Ans. 16l. 18s. 11$\frac{3}{4}$d.

59 at 7s. 10d.
Ans. 23l. 2s. 2d.

68 at 9s. 11$\frac{1}{4}$d.
Ans. 33l. 15s. 9d.

79 at 11s. 5$\frac{1}{4}$d.
Ans. 45l. 6s. 10$\frac{1}{4}$d.

94 at 12s. 2d.
Ans. 57l. 3s. 8d.

106 at 14s. 7$\frac{1}{4}$d.
Ans. 77l. 8s $\frac{1}{2}$d.

117 at 1l. 2s. 3d.
Ans. 130l. 3s. 3d.

19 at 13s. 2d.
Ans. 12l. 10s. 2d.

26 at 3s $\frac{1}{4}$d.
Ans. 3l 19s. 7$\frac{1}{2}$d.

31 at 17s. 5$\frac{1}{2}$d.
Ans. 27l. 1s. 2$\frac{1}{2}$d.

37 at 12s. 10$\frac{1}{4}$d.
Ans. 23l. 15s. 7$\frac{1}{4}$d.

39 at 7s. 3$\frac{1}{4}$d.
Ans. 14l. 5s. 2$\frac{1}{4}$d.

43 at 2s. 10d.
Ans. 6l. 1s. 10d.

47 at 5s. 2$\frac{1}{2}$d.
Ans. 12l. 4s. 9$\frac{1}{2}$d.

53 at 3l 15s. 2d.
Ans. 199l. 3s. 10d.

62 at 8s. 5d.
Ans. 26l. 1s. 10d.

74 at 10s. $\frac{1}{2}$d.
Ans. 37l. 3s. 1d.

86 at 7d.
Ans. 2l. 10s. 2d.

104 at 13s. 5$\frac{1}{2}$d.
Ans. 69l. 19s. 8d.

114 at 15s. 3$\frac{1}{4}$d.
Ans. 87l. 5s. 7$\frac{1}{2}$.

127 at 3l. 2d.
Ans. 382l. 1s. 2d.

II. EX-

II. EXAMPLES of WEIGHTS, MEASURES, &c.

lb.	*oz.*	*dwt.*	*gr.*
3	—	14	9
			3

cwt.	*qr.*	*lb.*
17	3	23
		5

Miles	*fur.*	*poles*
31	3	27
		7

yd.	*qr.*	*nl.*
53	1	3
		9

Tuns	*hds.*	*gal.*
19	3	17
		11

Hhd fir. pts.
Mult. 3 5 47 by 18.
Anſ. 71 *hds.* 30 *pints.*

las. qr. bus.
Mult. 5 3 7 by 72.
Anſ. 387 *laſ.* 9 *qrs.*

Mon. we. da.
Mult. 7 3 5 by 26.
Anſ. 206 *mo.* 4 *da.*

cwt. qr. lb.
Mult. 3 7 14 by 53.
Anſ. 178 *cwt.* 3 *qr.* 14 *lb.*

lb.	*oz.*	*dr.*	*ſc.*	*gr.*
13	5	3	1	14
				4

lb.	*oz.*	*dr.*
21	11	15
		6

yd.	*feet*	*inc.*
171	1	10
		8

ac.	*ro.*	*pol.*
15	2	29
		10

Hds.	*gal.*	*pin.*
53	33	3
		12

Bar. kild. gal.
Mult. 21 1 13 by 36.
Anſ. 787 *bar.* 1 *kil.* 9 *gal.*

Buſ. pec. gal.
Mult. 71 3 1 by 132.
Anſ. 9487 *bu.* 2 *pec.*

Days hrs. min.
Mult. 14 13 27 by 47.
Anſ. 684 *da.* 8 *hr.* 9 *m.*

cwt. lb.
Mult. 17 — 12 by 75.
Anſ. 1283 *cwt.* 4 *lb.*

COM-

COMPOUND DIVISION.

COMPOUND Diviſion is the dividing either a ſimple or compound number into any propoſed number of equal parts, whereof each ſhall be a compound number.

RULE.

1. Place the diviſor and dividend as in ſimple diviſion.

2. Begin at the higheſt denomination and divide each by the diviſor, writing the quotes under their reſpective dividends.

3. But if there be a remainder, after dividing any of the denominations except the leaſt, you muſt find how many of the next lower denomination it is equal to, and add to it the ſmall number (if any) which was in this denomination before; then divide the ſum.

I EXAMPLES *of* MONEY.

	l.	*s.*	*d.*		*l.*	*s.*	*d.*
3)	1	8	6	4)	1	10	8
	s.	*d.*			*s.*	*d.*	
5)	6	3		6)	4	9	
	s.	*d.*			*l.*	*s.*	
7)	11	11½		8)	1	1	
	s.	*d.*			*l.*	*s.*	*d.*
9)	12	9		10)	28	18	4
	l.	*s.*	*d.*		*l.*	*s.*	
11)	19	10	6	12)	40	8	

If

If the divisor exceed 12, it is best to divide continually by its component parts, as in simple division.

What is cheese *per cwt.* if 16 *cwt.* cost 30*l.* 18*s.* 8*d*?
Ans. 1*l.* 18*s.* 8*d.*

If 22 cost 24*l.* 4*s.* what is 1?
Ans. 1*l.* 2*s.*

Divide 5*l.* 14*s.* 8*d.* by 32. — *Quot.* 3*s.* 7*d.*

Divide 2*l.* 18*s.* 8*d.* into 44 equal parts.
Ans. each part is 1*s.* 4*d*

Divide 4592*l.* 10*s.* equally among 55 persons.
Ans. each one's share is 83*l.* 10*s.*

If 70 be 84*l*, what is 1?
Ans. 1*l* 4*s.*

If 88 cost 50*l.* 12*s.* what will 1 be?
Ans. 11*s* 6*d.*

Divide 34*l.* 10*s.* by 120.
Quot. 5*s.* 9*d.*

What is tobacco *per cwt.* if 18 *cwt.* cost 100*l.* 4*s.*
Ans. 5*l.* 11*s.* 4*d.*

If 27 cost 21*l.* 9*d.* what is 1? — *Ans.* 15*s.* 7*d.*

Divide 4*l.* 19*s.* by 36.
Quot. 2*s.* 9*d*

Divide 68*l.* 3*s.* 10*d.* into 49 equal parts.
Ans. each part is 1*l.* 7*s.* 10*d.*

Divide 7*l* 1*s* 9*d.* equally among 63 persons.
Ans. each one's share is 2*s.* 3*d.*

If 80 be 102*l.* what is 1?
Ans. 1*l.* 5*s.* 6*d.*

If 99 cost 31*l.* 2*s.* 10½*d.* what will 1 be?
Ans. 6*s.* 3½*d.*

Divide 45*l.* 7*s* 6*d* by 121 — *Quot.* 7*s.* 6*d.*

Note, The following examples require three divisions.

At 18*l.* 18*s.* *per cwt.* how much *per lb.*
Ans. 3*s.* 4½*d.*

Divide 81*l.* 8*s.* 8*d.* by 224 — *Quot.* 7*s.* 3¼*d.*

At 9*l.* 16*s.* *per cwt.* how much *per lb?*
Ans. 1*s.* 9*d.*

Divide 55*l.* 15*s.* 7½*d.* by 350. — *Quot.* 3*s.* 2¼*d.*

But if the divisor cannot be produced by the multiplication of small numbers, you must divide by it after the manner of long division.

EXAMPLES.

	l.	*s.*	*d.*	*s.*	*d.*	
17)	4	13	6	(5	6	
	l.	*s.*	*d.*	*l.*	*s.*	*d.*
29)	65	12	$10\frac{1}{4}$	(2	5	$3\frac{1}{4}$
	l.	*s.*	*d.*	*s.*	*d.*	
41)	6	6	5	(3	1	
	l.	*s.*	*d.*	*d.*		
86)	2	10	2	(7		

	l.	*s.*	*d.*	*s.*	*d.*	
19)	12	10	2	(13	2	
	l.	*s.*	*d.*	*s.*	*d.*	
37)	23	15	$7\frac{1}{4}$	(12	$10\frac{1}{4}$	
	l.	*s.*	*d.*	*l.*	*s.*	*d.*
53)	199	3	10	(3	15	2
	l.	*s.*	*d.*	*l.*	*d.*	
127)	382	1	2	(3	2	

II. EXAMPLES of WEIGHTS, MEASURES, &c.

	lb.	*oz.*	*dwt.*
4)	13	1	15(
	C.	*qr.*	*lb.*
7)	75	1	12(
	Miles	*fur.*	*pls.*
11)	58	5	12(
	yd.	*qr.*	*nls.*
17)	31	2	3(

	lb.	*oz.*	*dr.*	*sc*	*gr.*
6)	2	5	3	—	10(
	lb.	*oz.*	*dr.*		
9)	5	3	14(		
	yd.	*feet*	*in.*		
12)	150	1	7(		
	acr.	*ro.*	*pls.*		
26)	17	3	17(		

RULE-OF-THREE.

THE Rule-of-Three is that by which a number is found having to a given number the same proportion which is between two other given numbers. For this reason it is sometimes named the *rule of proportion*.

It is called the rule-of-three, because in each of its questions there are given three numbers at least. And because of its excellent and extensive use, it is often named the *golden rule*.

For the stating, or rightly placing down the three given numbers, observe the following

RULE.

1. Write down the number which is of the same kind with the answer or number required.

2. Consider whether the answer ought to be greater or less than this number: then write respectively the greater or

or less of the two remaining numbers on the right of it for the third, and the other on the left for the first number or term.

Multiply the 2d and 3d terms together, divide the product by the 1st, and the quotient will be the answer.

Note 1. When you can conveniently multiply and divide as in compound multiplication and division, it is best so to do.

2. But if not, reduce the compound terms to the lowest name mentioned in them, and the 1st and 3d to the same name if they be not so already; then will the answer be of the same name with the 2d term.

3. When there happens to be a remainder after division, reduce it to the name next below the last quotient, and divide by the same divisor; so shall the quote be so many of the said next name; do this so long as there is any remainder, till you have reduced it to the least name, and all the quotients together will be the answer.

4. If the 1st term, and either the 2d or 3d can be divided by any number, without remainder; let them be divided, and the quotients used instead of them.

5. There are four other methods of operation besides the general one above delivered, any of which, when possible, performs the work much shorter than it. They are thus:

First, Divide the 2d term by the first, multiply the quotient into the 3d, and the product will be the answer.

Second, Divide the 3d term by the 1st, multiply the quotient into the 2d, and the product will be the answer.

Third, Divide the 1st term by the 2d, divide the 3d by the quotient, and the last quotient will be the answer.

Fourth, Divide the 1st term by the 3d, divide the 2d by the quotient, and the last quotient will be the answer.

Examples

1. If 8 yards of cloth cost 24*s*. what will 96 yards cost?
Ans. 14*l*. 8*s*.

2. How many yards of cloth may be bought for 14*l*. 8*s*. when 8 yards cost 24*s*? —— *Ans*. 96*yds*.

3. What will be the price of 72 yards of cambric, of which 9 yards cost 5*l*. 12? —— *Ans*. 44*l*. 16*s*.

4. What will 9 yards of cambric cost, at the rate of 44*l*. 16*s*. for 72 yards? — — *Ans*. 5*l*. 12.

5. If 7 *cwt*. 1 *qr*. of sugar, cost 26*l*. 10*s*. 4*d*. what will be the price of 43 *cwt*. 2 *qrs*? — *Ans*. 159*l*. 2*s*.

6. What quantity of sugar may be bought for 159*l*. 2*s*. at the rate of 7 *cwt*. 1 *qr*. for 26*l*. 10*s*. 4*d*.
Ans. 43 *cwt*. 2 *qrs*.

7. How

7. How many yards of muslin may be bought for 44*l.* 16*s.* whereof 9 yards cost 5*l.* 12*s*? — *Ans.* 72 *yards.*

8. How much must be paid for 26 bags of hops, at 21*l.* 4*s.* for 8 bags? —— *Ans.* 68*l.* 18*s.*

9. How many men must be employed to finish a piece of work in 15 days, which 5 men can do in 24 days? *Ans.* 8 *men.*

10. How many yards of broad-cloth may be bought for 5*l.* 12*s* of which 72 yards cost 44*l.* 16*s.* — *Ans.* 9 *yds.*

11. What must be paid for 53 *ells eng.* 1 *qr.* of holland at the rate of 7*s.* 9½*d.* *per* yard? — *Ans.* 25*l.* 18*s.* 1¾*d.*

12. How many yards of matting, which is 2 feet 6 inches broad, will cover a floor which is 27 feet long and 20 broad? —— —— *Ans.* 216 *feet* or 72 *yds.*

13. What quantity of sugar may be bought for 26*l.* 10*s.* 4*d.* when the price of 43 *cwt.* 2 *qr.* is 159*l.* 2*s*? *Ans.* 7 *cwt.* 1 *qr.*

14. In how many days will 8 men finish a piece of work which 5 men can do in 24 days? — *Ans.* 15 *days.*

15. What must be paid for 8 bags of hops, when the price of 26 bags is 68*l.* 18*s.*? —— *Ans.* 21*l.* 4*s.*

16. A person breaking, owes in all, 977*l.* and has in money, goods, and recoverable debts, 420*l.* 6*s.* 3½*d.* supposing these things delivered to his creditors, what will they get *per* pound? —— *Ans.* 8*s.* 7¼*d.*

17. What must be given for a piece of silver weighing 73 *lb.* 5 *oz.* 15 *dwts.* at the rate of 5*s.* 9*d.* *per* ounce? *Ans.* 253*l.* 10*s.* ¾*d.*

18. Bought 3 casks of raisins, each weighing 3 *cwt.* 1 *qr.* 7 *lb.* neat, what will they cost at 2*l.* 6*s.* 6*d.* *per cwt?* —— —— *Ans.* 23*l.* 2*s.* 1½*d.*

19. A garrison being besieged, has 5 months provision in it, at the rate of 12 ounces a day for each man; but being informed that it cannot be relieved till after 9 months, how much *per* day must each man have that the provisions may last that time? — *Ans.* 6⅔ *ounces.*

20. What will the tax upon 763*l.* 15*s.* be, at the rate of 3*s.* 6*d.* *per* pound? —— *Ans.* 133*l.* 13*s.* 1½*d.*

21. How

21. How much silver may I have for 253*l.* 10*s.* 0¼*d.* at 5*s.* 9*d.* *per* ounce? — *Ans.* 73 *lb.* 5 *oz.* 15 *dwts.*

22. What will 7 *cwt.* 1 *qr.* of sugar cost, at the rate of 43 *cwt.* 2 *qr.* for 159*l.* 2*s?* — *Ans.* 26*l.* 10*s.* 4*d.*

23. What must be paid for 1 *cwt.* 3 *qr.* 17 *lb.* of wool, at 7*s.* 4*d.* the stone of 14 *lb?* — *Ans.* 5*l.* 11*s.* 6*d.* $3\frac{3}{7}$*q.*

24. What quantity of hops may be bought for 68*l.* 18*s.* of which 8 bags cost 21*l.* 4*s?* — *Ans.* 26 *bags.*

25. How many ells eng. of holland may be bought for 25*l.* 18*s.* 1¼*d.* at 7*s.* 9½*d.* *per* yard? *Ans.* 53 *ells eng.* 1*qr.*

26. A person breaking, owes to several 977*l.* but compounds with them for 8*s.* 7¼*d.* *per* pound, what must he pay them in all? — — *Ans.* 420*l.* 6*s.* 3¼*d.*

27. *A* borrowed of *B* 730*l.* for 8 months; afterwards *A* would requite *B*'s kindness by lending him 375*l.* required the time it must be lent.

Ans. 15 *mo.* 2 *we.* $2\frac{4}{75}$ *ds.*

28. What will 1 *qr.* 1 *nail* of velvet cost at 18*s.* 6*d.* *per* yard? —— —— *Ans.* 5*s.* 9*d.* $1\frac{4}{8}$*q.*

29. What must be given for 7 *c.* 3 *qr.* 14 *lb.* of cheese, at 1*l.* 14*s.* 2*d.* *per cwt?* —— *Ans.* 13*l.* 9*s.* 0¾*d.*

30. What is the price of 2 *c.* 1 *qr.* 12 *lb.* of beef, at 2*s.* 8*d.* *per* stone or 14 *lb?* — *Ans.* 2*l.* 10*s.* 3*d.* $1\frac{5}{7}$*q.*

31. A person breaking, compounds with his creditors for 8*s.* 7¼*d.* *per* pound, and at that rate he pays them in all 420*l.* 6*s.* 3¼*d.* What was his debt? — *Ans.* 977*l.*

32. Bought 73 *lb.* 5 *oz.* 15 *dwts.* of silver for 253*l.* 10*s.* 0¼*d.* What did it cost *per* ounce? — *Ans.* 5*s.* 9*d.*

33. If the tax upon 763*l.* 15*s.* be 133*l.* 13*s.* 1½*d.* at what rate is it *per* pound. — *Ans.* 3*s.* 6*d.* *per l.*

34. What must I pay for three-eighths of a ship, which is valued at 700*l.* —— —— *Ans.* 262*l.* 10*s.*

35. What will the carriage of 8 *c.* 3 *qrs.* 7 *lb.* cost at 10*d.* *per* stone? —— —— *Ans.* 2*l.* 18*s.* 9*d.*

36. If the carriage of 5 *c.* 14 *lb.* for 96 miles be 1*l.* 12*s.* 6*d.* how far may I have 3 *c.* 1 *qr.* carried for the same money? —— *Ans.* 151 *m.* 3 *fur.* $3\frac{1}{11}$ *poles.*

37. What cost 30 pieces of lead, each weighing 1 *c.* 12 *lb.* at the rate of 16*s.* 4*d.* *per cwt?* *Ans.* 27*l.* 2*s.* 6*d.*

38. Bought a ſilver tankard, weighing 1 *lb.* 7 *oz.* 14 *dwt.* what will it coſt me at 6*s.* 4*d.* the ounce?

Anſ. 6*l.* 4*s.* $9\frac{1}{5}$*d.*

39. What muſt be paid for 7 caſks of prunes, each weighing 2*c.* 1*qr.* 14*lb.* at 2*l.* 19*s.* 8*d.* *per cwt?*

Anſ. 49*l.* 11*s.* $11\frac{1}{2}$*d.*

40. Bought 14 pockets of hops, each weighing 1*c.* 1*qr.* 18*lb.* at 4*l.* 2*s.* 6*d.* *per cwt.* what do they come to? —— —— *Anſ.* 81*l.* 9*s.* $4\frac{1}{2}$*d.*

41. What muſt be given for 75 chaldrons, 7 buſhels of coals, at the rate of 1*l.* 13*s.* 6*d.* *per* chaldron?

Anſ. 125*l.* 9*s.* $0\frac{1}{6}$*d.*

42. How much muſt be paid for 17 *qrs.* 1 *peck* of corn, at 3*s.* 10*d.* *per* buſhel? —— *Anſ.* 26*l.* 2*s.* $3\frac{1}{2}$*d.*

43. What coſt 43 *qrs.* 5 *buſh.* of corn, at 1*l.* 8*s.* 6*d.* the quarter? —— —— *Anſ.* 62*l.* 3*s.* $3\frac{3}{4}$*d.*

44. How much a year will 173 *acres,* 2 *ro.* 14 *pls.* of land give at the rate of 1*l.* 7*s.* 8*d.* *per* acre?

Anſ. 240*l.* 2*s.* $7\frac{1}{20}$*d.*

45. What will 139 pigs of lead, weighing in all 243 *cwt.* 2 *qrs.* come to, at 9*l.* 18*s.* *per* fother of 21 *cwt?*

Anſ. 114*l.* 15*s.* 10*d.* $1\frac{2}{14}$*q.*

46. What muſt be paid for 73 pieces of lead, each weighing 1*c.* 3*qr.* 7*lb.* at 10*l.* 4*s.* *per* fother of $19\frac{1}{2}$ *cwt?* —— —— *Anſ.* 69*l.* 4*s.* 2*d.* $1\frac{1}{78}$*q.*

47. If 5 yards of cloth coſt 14*s.* 2*d.* what muſt be given for 9 pieces containing each 21 *yds.* 1 *qr?*

Anſ. 27*l.* 1*s.* $10\frac{1}{2}$*d.*

48. If a gentleman's Eſtate be worth 2107*l.* 12*s.* a year, what may he ſpend a day to ſave 500*l.* in the year?

Anſ. 4*l.* 8*s.* $1\frac{19}{365}$*d.*

RULE-OF-FIVE.

THIS rule is ſo called becauſe that in it there are five numbers or terms given to find a ſixth.—It is often named the *double rule-of-three,* becauſe its queſtions are ſometimes performed by two operations of the rule-of-three.

Note,

Note.——Of the five given numbers, three contain a supposition, and the other two a demand; one of the terms of supposition being of the same kind with the number required, and the other two of the same kind as the demanding terms.

RULE *for* STATING.

1. Write down the term of supposition which is of the same kind as the answer, for the middle term.

2. Take one of the other two terms of supposition, and of the demanding terms, both of a kind; and from the directions given in the *rule-of-three*, consider which places they would possess if a stating were made of them and the middle term only, and place them accordingly; do the same with the other term of supposition and its correspondent demanding one, writing the terms under each other which fall on the right and left of the middle term.

METHOD *of* OPERATION.

1. *By two operations.*—Take the two upper terms and the middle term in the same order as they stand, for the first stating of the rule-of-three: then take the fourth number resulting from the first stating, for the middle term, and the two under terms in the general stating, in the same order as they stand, for the extreme terms of the second stating; and the fourth term resulting from it will be the answer.

2. *By one operation.*——Multiply together the terms of which the one is above the other, on both sides of the middle term; then account the two products and the middle term as they stand, the three terms of a rule-of-three stating, and the fourth term thence resulting will be the answer.

EXAMPLES.

1. If 100*l* in one year gain 5*l.* interest, what will be the Interest of 750*l.* for 7 years? — *Ans.* 262*l.* 10*s.*

2. If 27*s* be the wages of 4 men for 7 days, what will be the wages of 14 men for 10 days? — *Ans.* 6*l.* 15*s.*

3. What principal will gain 262*l.* 10*s.* in 7 years, at 5*l. per cent. per Annum?* — — *Ans.* 750*l.*

4. If a Footman travel 130 miles in 3 days when the days are 12 hours long, in how many days of 10 hours each, may he travel 360 miles? — *Ans.* $9\frac{63}{65}$ *days.*

5. A wall which was to be built to the height of 27 feet, was raised to the height of 9 feet by 12 men in 6 days; how many men must be employed to finish the wall in 4 days, at the same rate of working? *Ans.* 36 *men.*

6. If the price of 10 ounces of bread, when the corn is at 4*s.* 3*d. per* bushel, be $3\frac{1}{2}$*d.* what must be paid for 2 *lb.* 3 *oz.* when the corn is 5*s. per* bushel? — *Ans.* $11\frac{2}{17}$*d.*

7. What is the interest of 340*l.* for $2\frac{1}{2}$ years, at $4\frac{1}{2}$*l. per cent. per ann.* —— —— *Ans.* 38*l.* 5*s.*

8. If 120 bushels of corn can serve 14 horses 56 days, how many days will 94 bushels serve 6 horses?

Ans. $102\frac{4}{7}$ *days.*

9 If 7 *oz.* 5 *dwts.* of bread be bought for $4\frac{3}{4}$*d.* when corn is at 4*s.* 2*d. per* bushel, what weight of it may be bought for 1*s.* 2*d.* when the price of the bushel is 5*s.* 6*d?*

Ans. 1 *lb.* 4 *oz.* $3\frac{479}{627}$ *dwts.*

10. If the carriage of 13 *cwt.* 1 *qr.* for 72 miles be 2*l.* 10*s.* 6*d.* what will be the carriage of 7 *cwt.* 3 *qrs* for 112 miles? — — *Ans.* 2*l.* 5*s.* 11*d.* $1\frac{77}{175}$*q.*

11. What is the interest of 300*l.* for 5 weeks, at 5*l. per cent. per ann?* — — *Ans.* 1*l.* 8*s.* $10\frac{3}{7}$*d.*

12. If 3000 *lb.* of beef serve 340 seamen 15 days, how many *lb.* will serve 120 seamen 25 days?

Ans. 1764 *lb.* $11\frac{5}{17}$*oz.*

VULGAR FRACTIONS.

A FRACTION, or broken number, is an expression of one or more parts of any number.

The number of parts into which the number is supposed to be divided, is called the *denominator;* and the number of those parts expressed by the fraction, is called the *numerator.*—Also these two numbers are in general named the *terms* of the fraction.

If the number of which the fraction is part, or parts, be 1, it is called a *simple* fraction; and is denoted by the numerator wrote above the denominator with a small line between them: So, $\frac{1}{4}$, denotes one-fourth of 1; $\frac{3}{5}$, denotes three-fifths of 1. But

But if the number be different from 1, the fraction is called a *compound* one, and is denoted by the word *of*, and the number ſubjoined to the numerator and denominator expreſſed as before: So, $\frac{1}{4}$ of 6, denotes one-fourth of 6; $\frac{3}{5}$ of 8, denotes three-fifths of 8; and $\frac{2}{3}$ of $\frac{3}{4}$, denotes two-thirds of three-fourths of 1.

Simple fractions, whoſe numerators are leſs than their denominators, are called *proper* fractions.—And thoſe whoſe numerators are equal to or greater than their denominators, are called *improper* fractions.

The expreſſion formed from an integer and a fraction joined together, is called a *mixt number*.

Note 1. Simple fractions whoſe numerators are leſs than, equal to, or greater than their denominators, are reſpectively leſs than, equal to, or greater than 1.

2. A fraction, having a fraction or mixt number for its numerator, or denominator, or both, is by ſome, called a Complex fraction.

3. A whole or integer number may be expreſſed like a fraction by writing 1 under it for a denominator: So, 3 may be denoted by $\frac{3}{1}$ and 12 by $\frac{12}{1}$.

4	$=$	denotes	equ.	and is named	is equal to	thus	
	$+$		add.		*plus*, or more		$8 + 2 = 10$
	$-$		ſub.		*minus*, or leſs		$8 - 2 = 6$
	$\times$		mul.		into		$8 \times 2 = 16$
	$\div$		div.		by		$8 \div 2 = 4$

Beſides theſe, $\backsim$ is wrote between two numbers to denote their difference when it does not appear whether of them is the greater; as $\frac{13}{17} \backsim \frac{91}{103}$ denotes the difference of theſe two fractions.

REDUCTION *of* VULGAR FRACTIONS.

I. TO *abbreviate, or reduce fractions to leſs terms.*

RULE 1.

Divide the terms of the given fraction by any number which will divide them without a remainder, ſo ſhall the quotients be the terms of a new fraction, equal in value to the former; and this you may abbreviate again, and the next again, and ſo on, till it appear that there is no number greater than 1 which will divide them, in which caſe the fraction is ſaid to be in its *leaſt* terms.

EXAMPLES.

Let $\frac{42}{72}$ be propoſed to be abbreviated.

$\frac{42}{72} = \frac{21}{36} = \frac{7}{12}$.

Reduce $\frac{56}{72}$ to its leaſt terms.

Reduce $\frac{124}{96}$ to its leaſt terms.

Reduce $\frac{212}{464}$ to its leaſt terms.

Note 1. Any number ending with an even number, or a cypher, may be divided by 2.

EXAMPLES.

$\frac{16}{24} = \frac{8}{12} = \frac{4}{6} = \frac{2}{3}$.

$\frac{32}{56} =$

$\frac{140}{236} =$

2. Any number ending with 5 or 0 is diviſible by 5.

EXAMPLES.

$\frac{35}{40} = \frac{7}{8}$.

$\frac{75}{100} =$

3. Any number is diviſible by 3 if the ſum of its digits be ſo: Thus 417 is diviſible by 3, becauſe 12, which is the ſum of 4, 1, and 7, is ſo.

EXAMPLES.

$\frac{45}{120} = \frac{15}{40} = \frac{3}{8}$.

$\frac{126}{411} =$

$\frac{534}{672} =$

4. If there be any cyphers at the end of each, cut off ſo many as are common to both.

EXAMPLES.

$\frac{200}{340} = \frac{20}{34} = \frac{10}{17}$.

$\frac{1200}{18000} =$

5. When any number, which is expreſſed by ſeveral others with the ſign of addition or ſubtraction between them, is to be divided by any number, then all the parts of it muſt be divided by this number.

Thus $\frac{4+6-8}{2} = 2 + 3 - 4 = 5 - 4 = 1$.

6. But if the given number be expreſſed by others with the ſign of multiplication between them, only one of them muſt be divided: So

$$\frac{3\times8\times10}{2\times6} = \frac{3\times4\times10}{1\times6} = \frac{1\times4\times10}{1\times2} = \frac{1\times2\times10}{1\times1} = \frac{20}{1} = 20.$$

And, in this caſe, when the ſame number is in both the numerator and denominator, it may be left out of them.

EX-

EXAMPLES.

$\frac{2\times7\times9}{3\times2\times14}=$

$\frac{5\times2\times6}{3\times5\times2}=$

$\frac{7\times18\times40\times9}{10\times9\times7\times6}=$

RULE 2.

If the fraction muſt be brought to its leaſt terms at one diviſion; divide its terms by their greateſt common-meaſure, which common-meaſure is found by dividing the greater term by the leſs, and this diviſor by the remainder; and ſo on, always dividing the laſt diviſor by the laſt remainder, till o remain; then is the laſt diviſor the greateſt common-meaſure required.

EXAMPLES.

Reduce $\frac{246}{372}$ to its leaſt terms at one diviſion.

Firſt, 246)372(1

126)246(1

120)126(1

common-meaſure 6)120(20

Then $\frac{246\div6}{372\div6}=\frac{41}{62}$.

Reduce $\frac{748}{918}$ to its leaſt terms.

Reduce $\frac{514}{216}$ to its leaſt terms.

Reduce $\frac{5210}{5718}$ to its leaſt terms.

II. *To reduce an improper fraction to its equivalent whole or mixt number.*

RULE.

Divide the numerator by the denominator, and the quotient will be the integer or mixt number required.

EXAMPLES.

$\frac{12}{3}=4.$ | $\frac{15}{7}=2\frac{1}{7}.$

$\frac{14}{9}=$ | $\frac{257}{12}=$

III. *To reduce an integer to an equivalent fraction of a given denomination.*

RULE.

RULE.

Multiply the integer by the given denominator, and the product will be the numerator required.

EXAMPLES.

Reduce 7 to a fraction whose denominator shall be 4.

$7 = \frac{7 \times 4}{4} = \frac{28}{4}$.

Reduce 5 to a fraction whose denominator shall be 9.

Reduce 13 to a fraction whose denominator shall be 12.

IV. *To reduce a mixt number to an equivalent improper fraction.*

RULE.

Multiply the integer by the denominator of the fraction, to the product add the numerator; then the sum wrote above the denominator will form the fraction required.

EXAMPLES.

Reduce $2\frac{3}{7}$ to a fraction.

$$2\tfrac{3}{7} = \frac{2 \times 7 + 3}{7} = \frac{14+3}{7} = \frac{17}{7}.$$

Reduce $12\frac{7}{9}$ to a fraction.

Reduce $14\frac{7}{10}$ to a fraction.

V. *To reduce a compound fraction to an equivalent simple one.*

RULE.

Multiply all the numerators together for the numerator, and all the denominators together for the denominator of the simple fraction required.

Note, If part of the compound fraction be an integer or a mixt number, reduce it to a fraction by one of the former cases.

EXAMPLES.

Reduce $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of 5 to a simple fraction.

$\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{5}{1} = \frac{1 \times 2 \times 3 \times 5}{2 \times 3 \times 4 \times 1} =$ (by omitting the common terms 1, 2, & 3) $\frac{5}{4}$.

Reduce $\frac{2}{5}$ of $\frac{5}{8}$ of $3\frac{1}{2}$ to a simple fraction.

Reduce $\frac{2}{7}$ of $\frac{5}{9}$ of $\frac{7}{2}$ of 4 to a simple fraction.

VI. *To*

VI. *To reduce fractions of different denominations to equivalent fractions of a common one.*

RULE.

Multiply each numerator continually into all the denominators except its own, for each new numerator; and multiply all the denominators together for the common denominator.

N. B. It is evident, that in this, and several other operations, when any of the proposed quantities are integers, mixt numbers, or compound fractions, they must first be reduced by their proper rules to the form of simple fractions.

EXAMPLES.

Reduce $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{3}{4}$ to a common denomination.

$\frac{1}{2}$, $\frac{2}{3}$, *and* $\frac{3}{4} = \frac{1\times3\times4}{2\times3\times4}$, $\frac{2\times2\times4}{2\times3\times4}$, *and* $\frac{3\times2\times3}{2\times3\times4} = \frac{12}{24}$, $\frac{16}{24}$, *and* $\frac{18}{24} = \frac{6}{12}$, $\frac{8}{12}$, *and* $\frac{9}{12}$.

Reduce $\frac{2}{7}$ and $\frac{5}{9}$ to a common denomination.

Reduce $\frac{7}{3}$, $\frac{3}{5}$, and $5\frac{1}{6}$ to fractions of a com. denom.

Reduce $\frac{5}{6}$, $2\frac{3}{5}$ and 4 to fractions of a com. denom.

Note 1. If the denominators of the given fractions have a common measure, conceive them to be divided by it; then multiply the terms of each given fraction by the quotients of all the denominators, and you will thereby have the new fractions in lower terms than by the general rule.

EXAMPLES.

Reduce $\frac{1}{12}$, $\frac{7}{8}$, and $\frac{5}{24}$ to a common denomination.

The common measure of these denominators being 4, *the quotes are* 3, 2, *and* 6; *then*

$\frac{1}{12}$, $\frac{7}{8}$, *and* $\frac{5}{24}$, $= \frac{1\times2\times6}{12\times6\times2}$, $\frac{7\times3\times6}{8\times3\times6}$, $\frac{5\times3\times2}{24\times3\times2} = \frac{1\times2}{12\times2}$, $\frac{7\times3}{8\times3}$, *and* $\frac{5}{24}$, $= \frac{2}{24}$, $\frac{21}{24}$, *and* $\frac{5}{24}$.

Reduce $\frac{5}{12}$, $\frac{5}{14}$, and $\frac{1}{28}$ to a common denominator.

Reduce $\frac{5}{8}$, $\frac{3}{16}$, and $\frac{7}{20}$ to a common denomination.

2. Wherefore, if there be only two fractions proposed, multiply the terms of each by the quotient of the denominator of the other.

Reduce $\frac{7}{9}$ and $\frac{4}{15}$ to a common denomination.

$\frac{7}{9}$ *and* $\frac{4}{15} = \frac{7\times5}{9\times5}$ *and* $\frac{4\times3}{15\times3} = \frac{35}{45}$ *and* $\frac{12}{45}$.

Reduce $\frac{2}{15}$ and $\frac{3}{20}$ to a common denomination.

Reduce $\frac{5}{14}$ and $\frac{4}{21}$ to a common denominator.

3. If

3. If the greatest denominator be divisible by all the rest of the denominators, multiply the terms of all the other fractions by the respective quotients.

EXAMPLES.

Reduce $\frac{1}{12}$, $\frac{7}{8}$, and $\frac{5}{24}$ to a common denomination.

$\frac{1}{12}$, $\frac{7}{8}$, *and* $\frac{5}{24} = \frac{1\times2}{12\times2}$, $\frac{7\times3}{8\times3}$, *and* $\frac{5}{24} = \frac{2}{24}$, $\frac{21}{24}$, *and* $\frac{5}{24}$.

Reduce $\frac{5}{7}$, $\frac{5}{14}$, and $\frac{9}{28}$ to a common denomination.

Reduce $\frac{5}{6}$, $\frac{2}{3}$, and $\frac{7}{12}$ to a common denomination.

4. Whence, if there be only two fractions proposed, multiply the terms of that having the less denominator by the quotient of their denominators.

EXAMPLES.

Reduce $\frac{2}{3}$ and $\frac{5}{12}$ to a common denomination.

$\frac{2}{3}$ *and* $\frac{5}{12} = \frac{2\times4}{3\times4}$ *and* $\frac{5}{12} = \frac{8}{12}$ *and* $\frac{5}{12}$.

Reduce $\frac{2}{5}$ and $\frac{3}{15}$ to a common denomination.

Reduce $\frac{4}{9}$ and $\frac{5}{27}$ to a common denomination.

VII. *To reduce fractions to other equivalent ones of a different integer*; a certain number of the less integer being contained in one of the greater.

RULE.

Consider how many of the less integer make one of the greater; and by that number, multiply the numerator if the reduction be to a less integer, or the denominator, if to a greater.

EXAMPLES.

Reduce $\frac{2}{9}$ *l.* to the fraction of a shilling.

$\frac{2}{9} l. = \frac{2\times20}{9} s. = \frac{40}{9} s.$

Reduce $\frac{40}{9}$ *s.* to the fraction of a *l.*

$\frac{40}{9} s. = \frac{40}{9\times20} l. = \frac{2}{9} l.$

Reduce $\frac{2}{15}$ *l.* to the fraction of a penny.

Reduce 32 *d.* or $\frac{32}{1}$ *d.* to the fraction of a *l.*

Reduce $\frac{5}{11}$ *l.* to the fraction of a farthing.

Reduce $\frac{1600}{7}$ of a farthing to the fraction of a *l.*

Reduce $\frac{2}{7}$ *cwt.* to the fraction of a *lb.*

Reduce 32 *lb.* or $\frac{32}{1}$ *lb.* to the fraction of a *cwt.*

Note, If a compound whole number be proposed, reduce it all to the lowest denomination mentioned in it, and proceed as before.

EXAMPLES.

Reduce 7*s.* 3*d.* to the fraction of a *l.* — *Anſ.* $\frac{29}{80}$ *l.*

Reduce $2\frac{3}{4}$*d.* to the fraction of a ſhilling.—*Anſ.* $\frac{11}{48}$ *s.*

Reduce 3*qr.* 14*lb.* to the fraction of a *cwt.*—*Anſ.* $\frac{7}{8}$ *cwt.*

VIII. *To reduce fractions to equivalent ones of a different integer*, when a certain number of the leſs are not exactly contained in the greater.

RULE.

1. By the laſt, reduce the given fraction to an equivalent one of ſuch an integer, whereof a certain number are contained in the integer to which the fraction muſt be brought, or which ſhall contain a certain number of this.

2. By the laſt alſo, reduce this fraction to an equivalent one of the integer required.

EXAMPLES.

Reduce $\frac{2}{7}$ of a *l.* to the fraction of a guinea.

$$\frac{2}{7}l. = \frac{2\times20}{7}s. = \frac{2\times20}{7\times21}gui. = \frac{40}{147}guineas.$$

Reduce $\frac{5}{8}$ of a crown to the fraction of a guinea.

Anſ. $\frac{25}{168}$.

Reduce $\frac{40}{147}$ of a guinea to the fraction of a *l.*—*Anſ.* $\frac{2}{7}$ *l.*

Reduce $\frac{5}{6}$ of a half-crown to the fraction of a ſhilling.

Anſ. $\frac{25}{12}$ or $2\frac{1}{12}$*s.*

Reduce $2\frac{1}{12}$ *s.* to the fraction of a half-crown.

Anſ. $\frac{5}{6}$ *of a half-crown.*

IX. *To find the value of proper fractions in numbers of inferior denominations.*

RULE.

Multiply the numerator by the integer and divide by the denominator.

EXAMPLES.

1. What is the $\frac{4}{5}$ of 2*l.* 6*s?*

```
  2l. 6s.
      4
 --------
5) 9  4
 --------
```

Anſ.—1 *l.* 16*s.* 9*d.* $2\frac{2}{5}$*q.*

2. Re-

2. Required the value of $\frac{2}{3}$ of a *l.*

$$
\begin{array}{l}
\quad 2 \\
\quad 20 \\
\hline
3)\ 40\ (\ 13s.\ 4d.\ \textit{Anf.} \\
\hline
\quad 1 \\
\quad 12 \\
\hline
\quad 12\ (\ 4d.
\end{array}
$$

3. Required the value of $\frac{3}{8}$ *l.* —— *Anf.* 7 *s.* 6 *d.*

4. What is the value of $\frac{4}{13}$ *l?* — *Anf.* 6 *s.* 1 *d.* $3\frac{5}{13}$ *q.*

5. What is the value of $\frac{2}{9}$ of a guinea? — *Anf.* 4 *s.* 8 *d.*

6. What is the value of $\frac{7}{9}$ of a shilling? — *Anf.* 9 *d.* $1\frac{1}{3}$ *q.*

7. What is the value of $\frac{2}{15}$ of 9 *s.* $10\frac{1}{2}$ *d?*
Anf. 1 *s.* 3 *d.* $3\frac{1}{5}$ *q.*

8. What is the value of $\frac{3}{4}$ of a *lb.* troy? — *Anf.* 9 *oz.*

9. What is the value of $\frac{3}{4}$ of a *lb.* avoirdupois? *Anf.* 12 *oz.*

10. What is the value of $\frac{5}{16}$ of a *cwt?* — *Anf.* 1 *qr.* 7 *lb.*

11. What is the value of $\frac{2}{7}$ of 3 *cwt.* 1 *qr.* 14 *lb?*
Anf. 3 *qr.* 24 *lb.*

12. What is the value of $\frac{3}{17}$ of a mile?
Anf. 1 *furlong,* 16 *pls.* 3 *yd.* 1 *f.* $9\frac{3}{17}$ *in.*

13. What is the value of $\frac{6}{7}$ of a yard? — *Anf.* 3 *qr.* $1\frac{5}{7}$ *nl.*

14. What is the value of $\frac{5}{19}$ of an acre?
Anf. 1 *rood,* $2\frac{2}{19}$ *pls.*

15. What is the value of $\frac{7}{8}$ of a tun of wine?
Anf. 3 *hhd.* 31 *gal.* 2 *qrts.*

16. What is the value of $\frac{2}{15}$ of a hhd. of ale?
Anf. 6 *gal.* $3\frac{1}{5}$ *qrts.*

17. What is the value of $\frac{5}{9}$ of a quarter of corn?
Anf. 4 *bush.* 1 *pec.* 1 *gal.* $2\frac{4}{9}$ *qr.*

18. What is the value of $\frac{3}{10}$ of a day? *Anf.* 7 *hrs.* 12 *min.*

19. What is the value of $\frac{5}{7}$ of a month? *Anf.* 2 *we.* 6 *ds.*

20. What is the value of $\frac{7}{16}$ of an ell english?
Anf. 1 *qr.* 3 *nls.*

A D-

ADDITION *of* VULGAR FRACTIONS.

RULE.

REduce compound fractions to ſimple ones, and all to the ſame integer and denominator if they be different; then the ſum of the numerators wrote over the common denominator will be the ſum of the fractions required.

EXAMPLES.

1. What is the ſum of $\frac{5}{8}$, $7\frac{1}{2}$ and $\frac{1}{3}$ of $\frac{3}{4}$?

$\frac{5}{8} + 7\frac{1}{2} + \frac{1}{3}$ of $\frac{3}{4} = \frac{5}{8} + 7\frac{1}{2} + \frac{1}{4} = \frac{5}{8} \quad 7\frac{4}{8} + \frac{2}{8} = 7\frac{5+4+2}{8}$ $= 7\frac{11}{8} = 8\frac{3}{8}$ *the ſum.*

2. What is the ſum of $\frac{3}{5}$ and $\frac{4}{5}$? — *Anſ.* $1\frac{2}{5}$.

3. What is the the ſum of $\frac{2}{7}$ and $\frac{5}{14}$? — *Anſ.* $\frac{9}{14}$.

4. What is the ſum of $\frac{2}{3}$, $\frac{3}{5}$ and $\frac{5}{7}$? — *Anſ.* $1\frac{103}{105}$.

5. What is the ſum of $\frac{5}{9}$, $\frac{3}{5}$ and $2\frac{5}{6}$? — *Anſ.* $3\frac{29}{90}$.

6. What is the ſum of $\frac{3}{5}$, $\frac{4}{5}$ of $\frac{1}{3}$, and $9\frac{3}{10}$? *Anſ.* $10\frac{\text{[illegible]}}{60}$.

7. What is the ſum of $\frac{2}{3}$ of a pound, and $\frac{5}{9}$ of a ſhilling? — — *Anſ.* $\frac{125}{9}$ *s. or* 13 *s.* 10 *d.* $2\frac{2}{3}$ *q.*

8. What is the ſum of $\frac{3}{5}$ *s.* and $\frac{4}{15}$ *d.*?

Anſ. $\frac{112}{15}$ *d. or* 7 *d.* $1\frac{13}{15}$ *q.*

9. What is the ſum of $\frac{1}{7}$ *l.* $\frac{2}{9}$ *s.* and $\frac{5}{12}$ *d.*?

Anſ. $\frac{3139}{1008}$ *s. or* 3 *s.* 1 *d.* $1\frac{10}{21}$ *q.*

10. Suppoſe that I have $\frac{3}{8}$ of a ſhip worth 1500 *l.* and that I buy another perſon's ſhare of her, which is $\frac{5}{16}$; what part of her belongs to me then, and what is it worth? — — *Anſ. I have* $\frac{11}{16}$ = 1031 *l.* 5 *s.*

SUBTRACTION *of* VULGAR FRACTIONS.

RULE.

THE ſame preparations being made here as in addition; the difference of the numerators wrote above the common denominator will be the difference of the fractions required.

Note, in ſubtracting mixt numbers, when the fraction in the ſubtrahend is greater than that in the minuend, ſubtract the numerator of the ſubtrahend from the denominator, and to the difference add the numerator of the minuend; and carry one to the integer in the ſubtrahend.

EXAMPLES.

1. What is the difference between $\frac{5}{6}$ and $\frac{1}{6}$?

$$\frac{5}{6} - \frac{1}{6} = \frac{5-1}{6} = \frac{4}{6} = \frac{2}{3} \text{ } \textit{Anſ.}$$

2. What is the difference between $\frac{15}{22}$ and $\frac{11}{17}$?

$\frac{15}{22} \backsim \frac{11}{17} = \frac{15\times17}{22\times17} \backsim \frac{11\times22}{17\times22} = \frac{255-242}{17\times22} = \frac{13}{17\times22} = \frac{13}{374}$ *Anſ.*

3. What is the diff. between $\frac{5}{12}$ and $\frac{7}{12}$? — *Anſ.* $\frac{1}{6}$.

4. What is the diff. between $\frac{3}{13}$ and $\frac{4}{39}$? — *Anſ.* $\frac{5}{39}$.

5. What is the diff. between $\frac{5}{12}$ and $\frac{7}{13}$? — *Anſ.* $\frac{10}{156}$.

6. What is the diff. between $5\frac{1}{8}$ and $\frac{2}{7}$ of $4\frac{1}{6}$?

Anſ. $4\frac{31}{168}$.

7. What is the diff. between $\frac{5}{9}$ of a *l.* and $\frac{2}{3}$ of $\frac{3}{4}$ of a ſhilling? — *Anſ* $\frac{191}{18}$*s.* or 10*s.* 7*d.* $1\frac{1}{3}$*q.*

8. What is the diff. between $\frac{2}{7}$ of $5\frac{1}{6}$*l.* and $\frac{3}{5}$ of a ſhilling? — — *Anſ.* $\frac{3037}{2100}$*l.* or 1*l.* 8*s.* $11\frac{3}{35}$*d.*

9. Suppoſe that I have $\frac{5}{8}$ of a ſhip which is worth 900*l.* and that I ſell $\frac{2}{3}$ of my ſhare; what part of her have I left, and what is it worth? *Anſ.* $\frac{5}{24}$ = 187*l.* 10*s.*

MUL-

MULTIPLICATION *of* VULGAR FRACTIONS.

RULE.

REduce mixt numbers, if there be any, to fractions; then multiply all the numerators together for the numerator, and all the denominators together for the denominator of the product required.

Note, A fraction is best multiplied by an integer, by dividing the denominator by it if possible; but if not, multiply the numerator by it.

EXAMPLES.

1. What is the product of $\frac{2}{3}$, $3\frac{1}{4}$, 5, and $\frac{3}{4}$ of $\frac{3}{5}$?

$\frac{2}{3} \times 3\frac{1}{4} \times 5 \times \frac{3}{4}$ of $\frac{3}{5} = \frac{2 \times 13 \times 5 \times 3 \times 3}{3 \times 4 \times 4 \times 5} = \frac{13 \times 3}{2 \times 4} = \frac{39}{8} = 4\frac{7}{8}$ *Ans.*

2. What is the product of $\frac{2}{7}$ and $\frac{5}{8}$? — *Ans.* $\frac{5}{28}$.
3. What is the product of $\frac{4}{15}$ and $\frac{5}{24}$? — *Ans.* $\frac{1}{18}$.
4. What is the product of $\frac{3}{7}$, $\frac{4}{9}$ and $\frac{14}{15}$? — *Ans.* $\frac{8}{45}$.
5. What is the product of $\frac{1}{2}$, $\frac{2}{3}$ and 3? — *Ans* 1.
6. What is the product of $\frac{3}{14}$ and 7? — *Ans.* $1\frac{1}{2}$.
7. What is the product of $\frac{7}{9}$, $\frac{3}{5}$ and $4\frac{5}{14}$? — *Ans.* $2\frac{1}{30}$.
8. What is the product of $\frac{5}{6}$, and $\frac{2}{3}$ of $\frac{6}{7}$? — *Ans.* $\frac{10}{21}$.
9. What is the product of $5\frac{1}{3}$, and 9? — *Ans.* 48.
10. What is the product of 6, and $\frac{2}{3}$ of 5? — *Ans.* 20.
11. What is the product of $\frac{2}{9}$ of $\frac{3}{5}$, and $\frac{5}{8}$ of $3\frac{2}{7}$?
Ans. $\frac{23}{84}$.
12. What is the product of $3\frac{2}{7}$, and $4\frac{14}{33}$?
Ans. $14\frac{124}{231}$.
13. What is the product of 5, $\frac{2}{3}$, $\frac{2}{7}$ of $\frac{3}{5}$, and $4\frac{1}{6}$?
Ans. $2\frac{8}{21}$.

DIVISION *of* VULGAR FRACTIONS.

RULE.

HAving prepared the terms as in multiplication; take the quotient of the numerators and of the de-

nominators,

nominators, if poſſible, for the numerator and denominator of the fraction required; but if that cannot be done, multiply the dividend by the *reciprocal* of the diviſor, for the quotient required.

Note 1. By the reciprocal of a fraction, is meant the fraction got by inverting its terms: ſo the reciprocal of $\frac{2}{3}$ is $\frac{3}{2}$ and of 5 or $\frac{5}{1}$ is $\frac{1}{5}$.

2. A fraction is divided by an integer by dividing the numerator by it, if poſſible; but if not, multiply the denominator by it.

EXAMPLES.

1. What is the quotient of $\frac{25}{9}$ by $\frac{5}{3}$?

$$\frac{25}{9} \div \frac{5}{3} = \frac{25 \div 5}{9 \div 3} = \frac{5}{3} = 1\frac{2}{3} \text{ *Anſ.*}$$

2. What is the quotient of $\frac{5}{9}$ by $\frac{2}{15}$?

$$\frac{5}{9} \div \frac{2}{15} = \frac{5}{9} \times \frac{15}{2} = \frac{5 \times 15}{9 \times 2} = \frac{5 \times 5}{3 \times 2} = \frac{25}{6} = 4\frac{1}{6} \text{ *Anſ.*}$$

3. What is the quotient of $\frac{16}{25}$ by $\frac{4}{5}$? — *Anſ.* $\frac{4}{5}$.
4. What is the quotient of $\frac{7}{16}$ by $\frac{3}{4}$? — *Anſ.* $\frac{7}{12}$.
5. What is the quotient of $\frac{14}{9}$ by $\frac{7}{6}$? — *Anſ.* $1\frac{1}{3}$.
6. What is the quotient of $\frac{5}{6}$ by $\frac{15}{7}$? — *Anſ.* $\frac{7}{18}$.
7. What is the quotient of $\frac{12}{35}$ by $\frac{3}{5}$? — *Anſ.* $\frac{4}{7}$.
8. What is the quotient of $\frac{2}{7}$ by $\frac{3}{5}$? — *Anſ.* $\frac{10}{21}$.
9. What is the quotient of $\frac{9}{16}$ by 3? — *Anſ.* $\frac{3}{16}$.
10. What is the quotient of $\frac{3}{5}$ by 7? — *Anſ.* $\frac{3}{35}$.
11. What is the quotient of 5 by $\frac{7}{10}$? — *Anſ.* $7\frac{1}{7}$.
12. What is the quotient of $7\frac{1}{3}$ by $9\frac{5}{9}$? — *Anſ.* $\frac{33}{43}$.
13. What is the quotient of $\frac{2}{3}$ of $\frac{3}{9}$ by $\frac{5}{7}$ of $7\frac{3}{5}$?

Anſ. $\frac{7}{171}$.

RULE-OF-THREE *in* VULGAR FRACTIONS.

RULE.

HAving made the neceſſary preparations for multiplication, multiply continually together the 2d and 3d terms and the reciprocal of the 1ſt, for the anſwer.

EX-

EXAMPLES.

1. If $\frac{3}{8}$ of a yard of velvet coſt $\frac{2}{5}$ *l.* what will $\frac{5}{16}$ of a yard coſt?

$$\overset{yd.}{\tfrac{3}{8}} \text{ —— } \overset{l.}{\tfrac{2}{5}} \text{ —— } \overset{yd.}{\tfrac{5}{16}} \text{ —— } \overset{l.}{\frac{5\times2\times8}{16\times5\times3}} = \frac{1}{3} = 6s.\ 8d.\ \textit{Anſ.}$$

2. What will $3\frac{3}{8}$ *oz.* of ſilver coſt at 6*s.* 4*d.* an ounce? *Anſ.* 1*l.* 1*s.* $4\frac{1}{2}$*d.*

3. If $\frac{3}{16}$ of a ſhip be worth 273*l.* 2*s.* 6*d.* what is $\frac{5}{32}$ of her worth? — — *Anſ.* 227*l.* 12*s.* 1*d.*

4. What will $13\frac{2}{3}$ *lb.* coſt at the rate of $17\frac{5}{8}$*l.* *per cwt?* *Anſ.* 2*l.* $3\frac{3}{224}$*s.*

5. What is the purchaſe of 1230*l.* bank-ſtock, at $108\frac{5}{8}$ *per cent?* — — — *Anſ.* 1336*l.* 1*s.* 9*d.*

6. What is the intereſt of 273*l.* 15*s.* for a year, at $3\frac{1}{4}$ *per cent?* — — *Anſ.* 8*l.* 17*s.* $11\frac{1}{4}$*d.*

7. If $\frac{1}{8}$ of a ſhip be worth 73*l.* 1*s.* 3*d.* what part of her may I buy for 250*l.* 10*s?* — *Anſ.* $\frac{3}{7}$ *of her.*

8. What muſt be paid for $5\frac{2}{9}$ *oz.* at the rate of $5\frac{3}{4}$*s.* *per lb.* troy? — — — *Anſ.* 2*s.* $6\frac{1}{36}$*d.*

9. How much india-ſtock may be bought for 3041*l.* 2*s.* 3*d.* at $172\frac{3}{4}$*l.* *per cent?*—*Anſ.* 1760*l.* 8*s.* 2*d.* $3\frac{655}{691}$*q.*

10. What does the commiſſion of 530*l.* 2*s.* 9*d.* amount to at 2*s.* 6*d.* *per cent?* — *Anſ.* 13*s.* $3\frac{33}{800}$*d.*

11. How much flemiſh money muſt be given for 273*l.* 6*s.* 8*d.* ſterling, at the rate of 34*s.* 6*d.* flemiſh *per* pound ſterling? —— —— *Anſ.* 471*l.* 10*s.*

12. How much ſouth-ſea ſtock at $111\frac{3}{8}$ *per cent.* will 10000*l.* purchaſe? —— *Anſ.* 8978*l.* 13*s.* $6\frac{46}{297}$*d.*

13. How much ſterling money muſt be given for 471*l.* 10*s.* flemiſh, at the rate of 34*s.* 6*d.* flemiſh for each pound ſterling? —— *Anſ.* 273*l.* 6*s.* 8*d.*

RULE-OF-FIVE *in* VULGAR FRACTIONS.

RULE.

TAKE the continual product of the three last and reciprocals of the two first terms, for the answer required.

EXAMPLES.

1. If 2*l.* 10*s.* be the wages of 15 men for 6 days, what will be the wages of 12 men for $18\frac{1}{3}$ days?

$$\left.\begin{array}{r}15\ men\\ 6\ days\end{array}\right\} - \tfrac{5}{2}l. - \left\{\begin{array}{l}12\ men\\ \tfrac{55}{3}\ days\end{array}\right\} - 12 \times \tfrac{55}{3} \times \tfrac{5}{2} \times \tfrac{1}{15} \times \tfrac{1}{6} = \tfrac{12 \times 55 \times 5}{3 \times 2 \times 15 \times 6} = \tfrac{55}{3 \times 3} = \tfrac{55}{9}l. = 6l.\ 2s.\ 2d.\ 2\tfrac{2}{3}q.\ \textit{Anſ.}$$

2. What is the intereſt of 350*l.* for 18 months, at 5 *per cent. per annum?* —— —— *Anſ.* 26*l.* 5*s.*

3. If I pay 16*s.* 4*d.* for the carriage of, $5\frac{1}{4}$ *c. wt.* 20 miles, what muſt be paid for the carriage of $17\frac{3}{4}$ *c. wt.* $7\frac{1}{2}$ miles? —— —— *Anſ.* 1*l.* $8\frac{1}{2}$*d.*

4. If a footman travel 273 miles in $6\frac{2}{3}$ days of 12 hours long, in how many days of $9\frac{1}{3}$ hours each may he travel 132 miles? —— —— *Anſ.* $2\frac{178}{351}$ *days.*

DECIMAL FRACTIONS.

A Decimal is a fraction whoſe denominator is 1 with ſome number of ciphers annexed; as $\frac{1}{10}$, or $\frac{45}{10000}$.

Decimals are wrote down without their denominators, the numerators being ſo diſtinguiſhed as to evince what the denominators are; which is done by ſeparating, by a point, ſo many of the right-hand figures from the reſt as there are ciphers in the denominator; the figures on the left-hand of the point being integers, and thoſe on the right, decimals: So $\frac{13}{10}$ is wrote 1·3, and named 1 *and* 3 *tenths*; $\frac{15769}{1000}$ is wrote 15·769, and named 15 *and* 769 *thouſandth-parts*; and $\frac{250}{1000}$ is wrote ·25, and named 25

hun-

hundredths or *hundredth-parts* —But if there be not a sufficient number of figures in the numerator, cyphers are prefixed to supply the defect: So $\frac{1}{100}$ is wrote ·01, that is 1 *hundredth;* and $\frac{15}{10000}$ thus ·0015, that is 15 *ten-sandths.*

Note 1. The 1st, 2d, 3d, 4th, &c. places of decimals, counting from the left-hand towards the right, are denominated the places of primes, seconds, thirds, and fourths, &c. respectively.

2. Cyphers on the right of decimals do not affect their value.

ADDITION and SUBTRACTION of DECIMALS.

WRITE the proposed numbers under each other, according to the value of their places, as in whole numbers; in which order the decimal points will stand directly below each other: then add or subtract as in whole numbers, putting a decimal point in the sum or difference strait below the other points.

EXAMPLES in *Addition.*

1. What is the sum of 276, 39·213, 72014·9, 417, and 5032?

2. What is the sum of 7530, 16·201, 3·0142, 957·13, 6·72819, and ·03014?

3. What is the sum of 312·09, 3·5711, 4195·6, 71·498, 9739·215, 179 and ·0027?

4. What is the sum of ·014, ·9816, ·32, ·15914, 72913, and ·0047?

5. What is the sum of 27·148, 918·73, ·14016, 295304, ·713826, and 291·7?

EXAMPLES in *Subtraction.*

1. What is the difference between ·9173 and ·2138?
2. What is the difference of 1·9185 and 2·73?
3. What is the difference of 214·81 and 4·90142?
4. What is the difference of 91·713 and 407?
5. What is the difference of 2714 and ·916?

MUL-

MULTIPLICATION of DECIMALS.

WRITE down the factors and multiply exactly as in integers, placing the decimal point in the product so as to make just as many decimals in it as there are in both factors; and if there be not so many figures in the product as there ought to be decimals, prefix cyphers to supply the defect.

EXAMPLES.

1. What is the product of ·417 and 520·3?
2. What is the product of 91·78 and ·381?
3. What is the product of ·217 and ·053?
4. What is the product of 51·6 and 21?
5. What is the product of 314 and ·029?
6. What is the product of ·051 and ·09?

CONTRACTIONS.

(1.) *When decimals are to be multiplied by* 1 *with any number of cyphers;* it is done by only removing the decimal point so many places farther to the right hand as there are cyphers in the multiplier, and subjoining cyphers if need be.

EXAMPLES.

1. The product of 51·3 and 1000 is 51300.
2. The product of 2·714 and 100 is
3. The product of ·9163 and 1000 is
4. The product of 21·31 and 10000 is

(2.) *When the product will contain many more decimals than are necessary for the present purpose, the work may be contracted thus:*

Write the units figure of the multiplier streight under such decimal place of the multiplicand as you intend the last of your product shall be, writing the other figures of the multiplier in an inverted order; then in multiplying reject all the figures in the multiplicand which are on the right of the figure you are multiplying by; writing the products down so, that their right hand figures fall streight below each other; and carrying to such right hand figures

gures from the product of the two preceding figures in the multiplicand thus: *viz.* 1 from 5 to 15, 2 from 15 to 25, 3 from 25 to 35, &c. and the sum of the lines will be the product to the number of decimals required, and will be seldom wrong in the last figure.

EXAMPLES.

1. Multiply 27·14986 by 92·41035, so as to retain only four places of decimals in the product.

Contracted.	*Common way.*	
27·14986	27 14986	
53014·29	92 41035	
24434874	13	574930
542997	81	44958
108599	2714	986
2715	108599	44
81	542997	2
14	24434874	
2508·9280	2508·9280	650510

2. Multiply 480·14936 by 2 72416, retaining four decimals in the product.

3. Multiply 2490·3048 by ·573286, retaining five decimals in the product.

4. Multiply 325·701428 by ·7218393, retaining three decimals in the product.

DIVISION *of* DECIMALS.

DIvide as in integers; and to know how many decimals must be in the quotient, observe the following rules.

RULE 1.

The first figure of the quotient must possess the same place, of decimals or integers, as doth that figure of the dividend under which the units place of the first figure's product stands.

RULE 2.

The decimal places of the divisor and quotient together

ther must be equal in number to those in the dividend.—Whence

1. *If the number of decimal places in the divisor and dividend be equal,* the quotient will be integral.

Note, If, in this, or the following cases, there be a remainder after all the dividend figures are used, the quotient may be continued to what number of decimals you please by subjoining a cipher continually to the last remainder.

EXAMPLES.

·14) 7201 93 (3·75) 3·15 (
7·13) ·18 (·285) ·109 (

2. *If the number of decimals in the dividend exceed that of those in the divisor,* point off in the quotient so many as their difference is; and if there be not so many places in the quotient, prefix so many ciphers as will make up the number.

EXAMPLES.

8·4) 3·15 (2 17) 380·2196 (
519) ·3049 (·216) ·20913 (

3. *When the number of decimals in the dividend is less than that in the divisor,* annex ciphers to those in the dividend till they be equal; then will the quotient be integral, as in case 1.

EXAMPLES.

·216) 71 42 (4·913) 758·6 (
·00401) 2168 (8·73) 140896 (

CONTRACTIONS.

(1.) *If the divisor be an integer with any number of ciphers at the end,* cut them off, and remove the decimal point in the dividend so many places farther to the left as there were ciphers cut off, prefixing ciphers if need be; then proceed as before.

EXAMPLES.

2170) 45·5 (32000) 41020 (
21000) 953 (79000) 61 (

(2.) Whence, *if the divisor be* 1 *with ciphers,* the quotient will be the same figures with the dividend, having the decimal point so many places farther to the left as there are ciphers in the divisor.

EX-

EXAMPLES.

$217{\cdot}3 \div 100 = 2{\cdot}173$ 419 by $10 =$

$5{\cdot}16$ by $1000 =$ ${\cdot}21$ by $1000 =$

(3.) *When the number of figures in the divisor is great,* the division at large will be very troublesome, but may be contracted thus:

Having by the first general rule found what place of decimals or integers the first figure of the quotient will possess; consider how many figures of the quotient will serve the present purpose, then take the same number of the left-hand figures of the divisor, and so many of the dividend figures as will contain them (less than 10 times); by these find the first figure of the quotient, and for each following figure divide the last remainder by the divisor wanting one figure to the right more than before, but observing what must be carried to the first product for such omitted figures as in the second contraction of multiplication; and continue the operation till the divisor be exhausted.

Note, When there are not so many figures in the divisor as are required to be in the quotient, begin the division with all the figures as usual, and continue it till the number of figures in the divisor and of those remaining to be found in the quotient be equal, after which use the contraction.

EXAMPLES.

1. Divide 2508·928065051 by 92·41035 so as to have four decimals in the quotient, in which case the quotient will contain six figures.

```
92·4103,5) 2508·928,065051 (27·1498.
           ———————
             660721
           ———————
              13849
              —————
               4608
               ————
                912
               ————
                 80
                 ——
                  6
```

2. Divide 4109·2351 by 230·409 so that the quotient may contain four decimals.

3. Divide 37·10438 by 5713·96 that the quotient may contain five decimals.

4. Divide 913·08 by 2137·2 that the quotient may contain three decimals.

REDUCTION of DECIMALS.

*I. TO *reduce a vulgar fraction to an equivalent decimal.*

RULE.

Divide the numerator by the denominator as in division of decimals, and the quotient will be the decimal required.

EXAMPLES.

Reduce $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, and $\frac{1}{9}$ to decimals.

Re-

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* Since to throw any vulgar fraction, whose denominator is a prime number greater than what it is common to divide by in one line, into a decimal consisting of a great number of figures, has engaged the attention of many eminent persons, I shall here put down the method which Mr Colson has given in pag. 162 of Sir Isaac Newton's fluxions; which method performs the work much sooner than any other that I know of.

The method will be best explained by an example, thus: "Suppose (for Instance) I would find the reciprocal of the prime number 29, or the value of the fraction $\frac{1}{29}$ in decimal numbers. I divide 1·0000, &c. by 29, in the common way, so far as to find two or three of the first figures, or till the remainder becomes a single figure, and then I assume the supplement to compleat the quotient. Thus I shall have $\frac{1}{29} = 0{\cdot}03448\frac{8}{29}$ for the compleat quotient, which equation if I multiply by the numerator 8, it will give $\frac{8}{29} = 0{\cdot}27584\frac{64}{29}$, or rather $\frac{8}{29} = 0{\cdot}27586\frac{6}{29}$. I substitute this instead of the fraction in the first equation, and I shall have $\frac{1}{29} = 0{\cdot}0344827586\frac{6}{29}$. Again, I multiply this equation by 6, and it will give $\frac{6}{29} = 0{\cdot}2068965517\frac{7}{29}$, and then by substitution $\frac{1}{29} = 0{\cdot}03448275862068965517\frac{7}{29}$. Again, I multiply this equation by 7, and it becomes $\frac{7}{29} = 0{\cdot}24137931034482758620\frac{20}{29}$, and then by substitution $\frac{1}{29} = 0{\cdot}0344827586206896551724137931034482758620\frac{20}{29}$, where every operation will at least double the number of figures found by the preceding operation, And this will be an easy expedient for converting division into multiplication in all cases. For this reciprocal of the divisor being thus found, it may be multiplied into the dividend to produce the quotient."

Reduce $\frac{2}{7}$ to a decimal.

Reduce $\frac{14}{191}$ to a decimal.

Reduce $\frac{21}{758}$ to a decimal.

II. *To reduce integers or decimals to equivalent decimals of ſuperior denominations.*

CASE I.

If a ſimple number or decimal be propoſed, reduce it to the name required by dividing as in reduction of integers.

EXAMPLES.

1. Reduce 1 *dwt*. to the decimal of a *lb*.
Anſ. ·004166 &c. *lb*.

2. Reduce 9*d*. to the decimal of a pound.
Anſ. ·0375*l*.

3. Reduce 7 drams to the decimal of a *lb*. avoir.
Anſ. ·02734375*lb*.

4. Reduce ·26*d*. to the decimal of a *l*.
Anſ. ·0010833 &c. *l*.

5. Reduce 2·15 *lb*. to the decimal of a *cwt*.
Anſ. ·019196 + *cwt*.

6. Reduce 24 yards to the decimal of a mile.
Anſ. ·013636 &c. *mls*.

7. Reduce ·056 poles to the decimal of an acre.
Anſ. ·00035 *acr*.

8. Reduce 1·2 pints of wine to the decimal of a *hhd*.
Anſ. ·00238 + *hhd*.

9. Reduce 14 minutes to the decimal of a day.
Anſ. ·009722 &c. *da*.

10. Reduce ·21 pints to the decimal of a peck.
Anſ. ·013125 *pec*.

CASE 2.

A compound number may be reduced to a ſuperior name by reducing each of its parts, and taking the ſum of the decimals; the beſt way to do which is thus:

Write the given numbers under each other, proceeding orderly from the leaſt to the greateſt name, for dividends; draw a perpendicular line on the left of theſe, and on the left of it write oppoſite each dividend ſuch a number, for

G a di-

a divisor, as will reduce it to the next superior name; then begin with the upper division, and affix the quotient of each to the next dividend, as a decimal part of it, before it be divided, and the last sum will be the answer.

EXAMPLES.

1. Reduce $3l.$ $12s.$ $6\frac{1}{4}d.$ to the denomination of pounds.

4	3
12	6·75
20	12·5625
	3·628125 *Ans.*

2. Reduce $19l.$ $17s.$ $3\frac{1}{4}d.$ to $l.$

Ans. 19·86354166 &c. *l.*

3. Reduce 15*s.* 6*d.* to the decimal of *l.*—*Ans.* ·775*l.*

4. Reduce $7\frac{1}{2}d$ to the decimal of a shill.—*Ans.* ·625*s.*

5. Reduce 5 *oz.* 12 *dwts.* 16 *gr.* to *lbs.*

Ans. ·46944 &c. *lb.*

6. Reduce 3 *cwt.* 2 *qr.* 14 *lb.* to *cwts.* *Ans.* 3·625 *cwt.*

7. Reduce 17 *yd.* 1 *ft.* 6 *in.* to the decimal of a mile.

Ans. ·0099431818 &c. *mil.*

8. Reduce 2 *qr.* 3 *nls.* to the decimal of a yard.

Ans. ·6875 *yd.*

9. Reduce 13 *acr.* 1 *ro.* 14 *pol.* to acres.

Ans. 13·3375 *acr.*

10. Reduce 13 *gal.* 1 *pint* of wine to the decimal of a *hhd.* —— —— *Ans.* ·20833 &c. *hhd.*

11. Reduce 3 *bush.* 1 *pec.* to the decimal of a quarter.

Ans. ·40625 *qr.*

12. Reduce 3 *mon.* 1 *we.* 5 *da.* to months.

Ans. 3·42857+*mon.*

III. *To reduce a decimal of a superior denomination to its value in the inferior ones.*

RULE.

Multiply the given decimal by such a number as will reduce it to the next inferior name, and point off in the product so many places of decimals as are in the given number; then reduce these in the same manner to the next

next name, and continue the reduction to the lowest name required, or till the decimals pointed off be all ciphers: then the numbers on the left of the points will express the value of the decimal.

EXAMPLES.

1. What is the value of ·775*l*? — *Ans.* 15*s.* 6*d.*
2. What is the value of ·625*shil*? — *Ans.* 7½*d.*
3. What is the value of ·8635 *l.* — *Ans.* 17*s.* 3·24*d.*
4. What is the value of ·0125 *lb.* troy? — *Ans.* 3 *dwts.*
5. What is the value of ·4694 *lb.* troy?
Ans. 5 *oz.* 12 *dwt.* 15·744 *gr.*
6. What is the value of ·625 *cwt*? — *Ans.* 2 *qr.* 14 *lb.*
7. What is the value of ·009943 *mil.*
Ans. 17 *yd.* 1 *ft.* 5·98848 *inc.*
8. What is the value of ·6875 *yd*? — *Ans.* 2 *qr.* 3 *nls.*
9. What is the value of ·3375 *acr*?
Ans. 1 *rd.* 14 *poles.*
10. What is the value of ·2083 *hhd.* of wine?
Ans. 13·1229 *gal.*
11. What is the value of ·40625 *qr.* of corn?
Ans. 3 *bush.* 1 *pock.*
12. What is the value of ·42857 *mon*?
Ans. 1 *we.* 4 *ds.* 23·99904 *hrs.*

RULE-OF-THREE *in* DECIMALS.

REDUCE vulgar fractions to decimals, and compound numbers either to decimals of the higher names or to integers of the lower, as also the first and third to the same name: then state the question and proceed as in integers.

Note. Any of the convenient examples of the rules of three or five in integers or vulgar fractions may be taken as proper examples of the same rules in decimals; for it would be filling the book to ill purpose to give different examples here.——The following example, which is the first in vulgar fractions, is wrought here to shew the method.

If $\frac{3}{8}$ of a yard of velvet cost $\frac{2}{5}$ *l.* what will $\frac{5}{16}$ *yd.* cost?

$$\begin{array}{llll}
 & \textit{yd.} & \textit{l.} & \textit{yd.} \\
\frac{3}{8}=\cdot375 & \cdot375 & \text{——}\ \cdot4\ \text{——} & \cdot3125 \\
 & & & \cdot4 \\
\frac{2}{5}=\cdot4 & & \cdot375\ ) & \cdot12500\ (\cdot333333\ \&c. \\
 & & & 1125 \qquad\qquad 20 \\
\frac{5}{16}=\cdot3125 & & & 1250\ s.\ 6\cdot66666\ \&c. \\
 & & & 1125 \qquad\qquad 12 \\
 & & & 125\ d.\ 7\cdot99999\ \&c.
\end{array}$$

Note, The remainder, in the division, being always the same, the quotient figure must be so likewise; so that if the quotient were infinitely continued it would be equal to $\frac{1}{3}$ *l.* as in vulgar fractions.

RULE-OF-FIVE *in* DECIMALS.

THE same preparations must be made here as in the rule-of-three before the stating.

PRACTICE.

BY *rules of practice* are meant certain expeditious methods of casting up accounts: and they consist of the most general contractions of the rule-of-three when the first term is 1.

Note 1. One number is said to be an aliquot part of another, when the former divides the latter without a remainder.

2. When the quantity, whose price is to be found, is not very large, and of one denomination, it is commonly best to work it by compound multiplication; but if very large, or of several denominations, use the following rules of practice.

A TABLE *of the aliquot parts of money.*

s.	d.		l.	d.		l.		s.
10	—	is	$\frac{1}{2}$	6	is	$\frac{1}{40}$	or	$\frac{1}{2}$
6	8	—	$\frac{1}{3}$	5	—	$\frac{1}{48}$		
5	—	—	$\frac{1}{4}$	4	—	$\frac{1}{60}$	—	$\frac{1}{3}$
4	—	—	$\frac{1}{5}$	$3\frac{3}{4}$	—	$\frac{1}{64}$		
3	4	—	$\frac{1}{6}$	3	—	$\frac{1}{80}$	—	$\frac{1}{4}$
2	6	—	$\frac{1}{8}$	$2\frac{1}{2}$	—	$\frac{1}{96}$		
2	—	—	$\frac{1}{10}$	2	—	$\frac{1}{120}$	—	$\frac{1}{6}$
1	8	—	$\frac{1}{12}$	$1\frac{1}{2}$	—	$\frac{1}{160}$	—	$\frac{1}{8}$
1	4	—	$\frac{1}{15}$	$1\frac{1}{4}$	—	$\frac{1}{192}$		
1	3	—	$\frac{1}{16}$	1	—	$\frac{1}{240}$	—	$\frac{1}{12}$
1	—	—	$\frac{1}{20}$	$\frac{3}{4}$	—	$\frac{1}{320}$	—	$\frac{1}{16}$
	10	—	$\frac{1}{24}$	$\frac{1}{2}$	—	$\frac{1}{480}$	—	$\frac{1}{24}$
	8	—	$\frac{1}{30}$	$\frac{1}{4}$	—	$\frac{1}{960}$	—	$\frac{1}{48}$
	$7\frac{1}{2}$	—	$\frac{1}{32}$					

RULE I.

If the given price of 1 *or the integer be an aliquot part of a penny, ſhilling, or pound,* take the ſame part of the given quantity whoſe price is to be found (by dividing it by the number of times which the given price of 1 is contained in a penny, ſhilling, or pound) for the anſwer in pence, ſhillings, or pounds reſpectively.

EXAMPLES.

Queſtions.		s.	d.			*Anſwers.* l.	s.	d.
2103	at	10	—	——	——	1051	10	—
715	at	6	8	——	——	238	6	8
1496	at	5	—	——	——	374	—	—
420	at	4	—	——	——	84	—	—
831	at	3	4	——	——	138	10	—
275	at	2	6	——	——	34	7	6
937	at	2	—	——	——	93	14	—

 3890

Questions.					Answers.		
	s.	d.			l.	s.	d.
3890 at	1	8	——	——	324	3	4
624 at	1	4	——	——	41	12	—
159 at	1	3	——	——	9	18	9
472 at	1	—	——	——	23	12	—
521 at	—	10	——	——	21	14	2
376 at	—	8	——	——	12	10	8
916 at	—	7½	——	——	28	12	6
1270 at	—	6	——	——	31	15	—
835 at	—	5	——	——	17	7	11
609 at	—	4	——	——	10	3	—
581 at	—	3¾	——	——	9	1	6¾
716 at	—	3	——	——	8	19	—
1953 at	—	2½	——	——	20	6	10½
807 at	—	2	——	——	6	14	6
2305 at	—	1½	——	——	14	8	1½
3019 at	—	1¼	——	——	15	14	5¾
4718 at	—	1	——	——	19	13	2
1927 at	—	—¾	——	——	6	—	5¼
741 at	—	—½	——	——	1	10	10½
5804 at	—	—¼	——	——	6	—	11

RULE II.

If the given price be no aliquot part of a penny, ſhilling, or pound; divide it into ſeveral aliquot parts, then work for each by rule 1, and their ſum will be the anſwer.

Or, It may often be divided ſo, that the leſs will be aliquot parts of the greater; then take the ſame parts of the prices found for the greater.

EXAMPLES.

Queſtions.				Anſwers.		
	d.			l.	s.	d.
2173 — at	1¾	——	——	15	16	10¾
796 — at	2¼	——	——	7	9	3

1953

Questions.	*s.*	*d.*			*Answers.* *l.*	*s.*	*d.*
1953 at	—	$2\frac{1}{4}$	—	—	22	7	$6\frac{3}{4}$
3406 at	—	$3\frac{1}{4}$	—	—	46	2	$5\frac{1}{2}$
596 at	—	$3\frac{1}{2}$	—	—	8	13	10
802 at	—	$4\frac{1}{4}$	—	—	14	4	— $\frac{1}{2}$
1234 at	—	$4\frac{1}{2}$	—	—	23	2	9
370 at	—	$4\frac{3}{4}$	—	—	7	6	$5\frac{1}{2}$
951 at	—	$5\frac{1}{4}$	—	—	20	16	— $\frac{3}{4}$
603 at	—	$5\frac{1}{2}$	—	—	13	6	$4\frac{1}{2}$
239 at	—	$5\frac{3}{4}$	—	—	5	14	$6\frac{1}{4}$
1980 at	—	$6\frac{1}{4}$	—	—	51	11	3
271 at	—	$6\frac{1}{2}$	—	—	7	6	$9\frac{1}{2}$
714 at	—	$6\frac{3}{4}$	—	—	20	1	$7\frac{1}{2}$
591 at	—	7	—	—	17	4	9
275 at	—	$7\frac{1}{4}$	—	—	8	6	$1\frac{3}{4}$
596 at	—	$7\frac{3}{4}$	—	—	19	4	11
1490 at	—	$8\frac{1}{4}$	—	—	51	4	$4\frac{1}{2}$
621 at	—	$8\frac{1}{2}$	—	—	21	19	$10\frac{1}{2}$
4681 at	—	$8\frac{3}{4}$	—	—	170	13	$2\frac{3}{4}$
753 at	—	9	—	—	28	4	9
421 at	—	$9\frac{1}{4}$	—	—	16	4	$6\frac{1}{4}$
210 at	—	$9\frac{1}{2}$	—	—	8	6	3
765 at	—	$9\frac{3}{4}$	—	—	31	1	$6\frac{3}{4}$
461 at	—	$10\frac{1}{4}$	—	—	19	13	$9\frac{1}{4}$
273 at	—	$10\frac{1}{2}$	—	—	11	18	$10\frac{1}{2}$
536 at	—	$10\frac{3}{4}$	—	—	24	—	2
910 at	—	11	—	—	41	14	2
5391 at	—	$11\frac{1}{4}$	—	—	252	14	— $\frac{3}{4}$
372 at	—	$11\frac{1}{2}$	—	—	17	16	6
420 at	—	$11\frac{3}{4}$	—	—	20	11	3
2163 at	1	7	—	—	171	4	9

Questions.	*s.*	*d.*			*Answers.* *l.*	*s.*	*d.*
364 at	2	5	——	——	43	19	8
531 at	3	9	——	——	99	11	3
467 at	4	3	——	——	99	4	9
205 at	5	11	——	——	60	12	11
1734 at	6	10½	——	——	596	1	3
769 at	7	9	——	——	297	19	9
134 at	8	3¼	——	——	55	8	3½
410 at	9	7¾	——	——	197	14	9½
416 at	10	5½	——	——	217	10	8
305 at	11	9¼	——	——	179	10	1¼
1209 at	12	7	——	——	760	13	3
714 at	13	6	——	——	481	19	—
197 at	14	3½	——	——	140	15	5½
251 at	15	7	——	——	195	11	5
612 at	16	4¾	——	——	501	14	3
247 at	17	9	——	——	219	4	3
816 at	18	2¼	——	——	742	1	—
970 at	19	8	——	——	953	16	8

RULE III.

If there be pounds in the price, multiply the given quantity by the number of them; *and if there be also some odd money,* find its produce by the former rules, and add them together.

EXAMPLES.

Questions.	*l.*	*s.*	*d.*			*Answers.* *l.*	*s.*	*d.*
213 at	5	—	—	——	——	1065	—	—
708 at	17	—	—	——	——	12036	—	—
1150 at	2	7	6	——	——	2731	5	—
623 at	3	9	—	——	——	2149	7	—

Questions.					*Answers.*		
	l.	*s.*	*d.*		*l.*	*s.*	*d.*
407 at	1	13	5	—— ——	680	—	7
4613 at	1	5	7	—— ——	5900	15	11
941 at	7	—	4	—— ——	6602	13	8
318 at	4	6	10	—— ——	1380	13	—
532 at	2	15	6	—— ——	1476	6	—

RULE IV.

When there is some odd weight or measure in the quantity; after having multiplied the price by the number of integers (if there be any) divide the odd quantity into aliquot parts of the integer, or of each other; and take the same parts of the price of the integer, or of the price of each other, and add them all together.

A TABLE *of the aliquot parts of a* cwt.

lb.		*cwt.*	*lb.*		*cwt.*
56	is	$\frac{1}{2}$	4	is	$\frac{1}{28}$
28	—	$\frac{1}{4}$	$3\frac{1}{2}$	—	$\frac{1}{32}$
16	—	$\frac{1}{7}$	2	—	$\frac{1}{56}$
14	—	$\frac{1}{8}$	$1\frac{3}{4}$	—	$\frac{1}{64}$
8	—	$\frac{1}{14}$	1	—	$\frac{1}{112}$
7	—	$\frac{1}{16}$			

Note. Aliquot parts of most other things are easily found.

EXAMPLES.

Questions		*l.*	*s.*	*d.*		*Answers.* *l.*	*s.*	*d.*
17 *cwt.* 3 *qr.* —	at	1	7	—	*per cwt.*	23	19	3
1 *cwt* 1 *qr.* 8 *lb.*	at	1	17	—	- - - -	2	8	$10\frac{1}{2}$
2 *cwt.* 2 *qr.* —	at	3	14	3	- - - -	9	5	$7\frac{1}{2}$
2 *qr.* 2 *lb.* —	at	—	19	$7\frac{1}{2}$	- - - -	—	10	$1\frac{1}{4}$
3 *cwt.* $22\frac{1}{4}$ *lb.* —	at	—	13	$5\frac{1}{4}$	- - - -	2	3	2
2 *qr.* $18\frac{1}{4}$ *lb.* —	at	—	15	$2\frac{1}{4}$	- - - -	—	10	— $\frac{1}{2}$
3 *qr.* $12\frac{1}{2}$ *lb.* —	at	2	16	10	- - - -	2	8	$11\frac{1}{2}$

7 *cwt.*

Questions.	l.	s.	d.		Answers. l.	s.	d.
7 cwt. 2 qr. 15½ lb. at	3	—	7	per cwt.	23	2	9
3 ton, 5 c. 2 qr. — at	7	9	3	per ton.	24	8	9½
17 lb. 5 oz. 14 dwts. at	3	6	9	per lb.	58	6	5½
15 lb. 2 oz. 5 dwt. at	4	7	—	- - -	66	1	3¾
7 oz. 15 dwt. 12 gr. at	—	6	3	per oz.	2	8	7
5 oz. 6 dwts. 17 gr. at	—	5	10	- - -	1	11	1¼
3 yds. 1 qr. — at	—	17	6	per yd.	2	16	10½
4 yds. 2 qr. 3 nls. at	1	2	4	- - - -	5	4	8¼
1 qr. 2 nls. — at	1	12	6	- - - -	—	12	2¼
32 ac. 1 ro. 14 pls. at	1	16	—	per acre.	58	4	1¾
14 ac. 3 ro. 5 pls. at	2	12	10	- - - -	39	—	11¼
3 gal. 5 pints — at	—	7	6	per gal.	1	7	2¼
12 gal. 3 pts. — at	—	5	8	- - - -	3	10	1½

RULE V.

If the price be any even number of shillings; multiply the quantity by half their number, doubling the first figure of the product for shillings, the rest are pounds.

EXAMPLES.

Questions.	s.			Answers. l.	s.
173 at	2	——	——	17	6
259 at	4	——	——	51	16
703 at	6	——	——	210	18
5013 at	8	——	——	2005	4
872 at	10	——	——	436	—
460 at	12	——	——	276	—
627 at	14	——	——	438	18
598 at	16	——	——	478	8
214 at	18	——	——	192	12

RULE VI.

When the price is any odd number of shillings; work for the greatest even number contained in it by the last rule,

rule, and for the other ſhilling take $\frac{1}{20}$th of the given quantity as in rule 1. *Or*, multiply by the number of ſhillings, and divide the product by 20 to reduce it to pounds.

EXAMPLES.

Queſtions.		s.			*Anſwers.* l.	s.
732	at	3	——	——	109	16
147	at	7	——	——	51	9
371	at	9	——	——	166	19
586	at	11	——	——	322	6
240	at	13	——	——	156	—
652	at	15	——	——	489	—
897	at	17	——	——	762	9
1046	at	19	——	——	993	14

RULE VII.

If there be a fraction in the given quantity; after having worked for the integral part by any of the former rules, find the produce of the fraction by multiplying the price by the numerator and dividing the product by the denominator, then add them together for the anſwer.

EXAMPLES.

Queſtions.		l.	s.	d.			*Anſwers.* l.	s.	d.
$273\frac{1}{4}$	at	—	2	6	——	——	34	3	$1\frac{1}{2}$
$751\frac{1}{2}$	at	2	17	10	——	——	2173	1	9
$530\frac{1}{4}$	at	—	14	—	——	——	371	10	6
$178\frac{3}{8}$	at	—	17	—	——	——	151	12	$4\frac{1}{2}$
$231\frac{5}{8}$	at	—	7	$9\frac{1}{2}$	——	——	90	4	$8\frac{3}{4}$
$762\frac{1}{5}$	at	1	12	6	——	——	1239	4	6
$817\frac{3}{10}$	at	3	7	4	——	——	2751	11	$6\frac{1}{4}$

TARE

TARE *and* TRET.

GROSS *weight* of any commodity, is its own weight together with that of its package, whether caſk, cheſt, or whatever elſe.

Tare is the weight of the package, or an allowance made inſtead of it.—What remains after the tare is taken from the groſs, may be called *tare-ſuttle*, if there be more deductions.

Tret is an allowance of 4 *lb.* upon every 104 *lb.* of tare-ſuttle on account of duſt or other waſte.—What remains after tret is deducted, may be called *tret-ſuttle*, if there be any following deduction.

Cloff is an allowance of 2 *lb.* for every 3 *cwt.* and ſome ſay for every 100 *lb.* of tret-ſuttle, to make the weight hold good when ſold by retail.

When all the deductions are made, the laſt remainder is called *neat* or *net* weight.

Note 1. When the tare is at ſo much per cwt. it will be beſt to divide it into aliquot parts of it, like as in the rule of practice.

2. The tret being 4 to 104, or 1 to 26, will be found by taking the 26th part of the tare-ſuttle.

3. In calculating oil and ſpirits, $7\frac{1}{2}$ *lb.* neat are allowed to the gallon.

EXAMPLES.

1. Groſs 17 *cwt.* 3 *qr.* 14 *lb.* tare 12 *lb.* *per cwt.* tret 4 to 104, and cloff 2 to 100 or 1 to 50. How much neat?

	cwt.	*qr.*	*lb.*	
lb.	17	3	14	groſs.
$8 = \frac{1}{14}$	1	1	3	
$4 = \frac{1}{2}$	—	2	$15\frac{1}{2}$	
	1	3	$18\frac{1}{2}$	tare.
26	15	3	$23\frac{1}{2}$	tare-ſuttle.
	—	2	$12\frac{1}{4}$	tret.
50	15	1	$10\frac{1}{4}$	tret-ſuttle.
	—	1	$6\frac{1}{4}$	cloff.
	15	-	$4\frac{1}{2}$	neat.

2. What

2. What is the neat produce of 30 barrels of anchovies, weighing each 36*lb.* groſs, allowing 8*lb. per cent.* tare? —— —— —— *Anſ.* $993\frac{1}{7}$*lb.*

3. Groſs 12*cwt.* 14*lb.* tare 1*cwt.* 2*qr.* 18*lb.* how much neat? — — *Anſ.* 10*cwt.* 1*qr.* 24*lb.*

4. Suppoſe 3*cwt.* 1*qr.* 5*lb.* tare were allowed on 71*cwt.* 3*qr.* of tobacco; what would be the neat weight?

Anſ. 68*cwt.* 1*qr.* 23*lb.*

5. In five cheſts of ſugar, weighing 112*cwt.* 1*qr.* groſs; how much neat, allowing 121*lb.* tare?

Anſ. 111*cwt.* 19*lb.*

6. In 26 bags of hops, containing 73*cwt.* 3*qr.* groſs, tare 10*lb. per* bag; how much neat?

Anſ. 71*cwt.* 1*qr.* 20*lb.*

7. What is the neat weight of 20 barrels of figs, each 3*cwt.* 1*qr.* 5*lb.* groſs, tare 14*lb. per* Barrel?

Anſ. 63*cwt.* 1*qr.* 16*lb.*

8. In 15 *hhds.* of tobacco, each 2*cwt.* 1*qr.* 12*lb.* groſs, tare 1*qr.* 4*lb. per hhd.* how much neat?

Anſ. 31*cwt.* 8*lb.*

9. What is the neat weight of 3 barrels of indigo, each 3*cwt.* 2*qr.* groſs, tare $10\frac{1}{2}$*lb. per cwt?*

Anſ. 9*cwt.* 2*qr.* $1\frac{3}{4}$*lb.*

10. What is the neat weight of 4*hhds.* of ſugar, weighing as under,

	c.	*q.*	*lb.*	
groſs	3	2	14	tare of the whole 1*cwt.* 3*qr.* 5*lb.*
	5	1	7	
	2	3	18	
	1	3	26	

Anſ. 12*cwt.* 4*lb.*

11. Five caſks of raiſins, wt. *viz.*

	cwt.	*qr.*	*lb.*		*lb.*	
Nº 1.	3	2	12	tare	18	how much neat?
2.	2	3	9	—	16	
3.	4	1	17	—	23	
4.	5	-	8	—	27	
5.	1	3	20	—	14	

Anſ. 16*cwt.* 3*qr.* 24*lb.*

12. What is the neat weight of the three following lots of wormseed? *viz.*

	cwt.	*qr.*	*lb.*	
N° 1.	3	2	8	— tare 12 *lb.* each.
2.	2	3	26	
3.	3	1	15	*Ans.* 9 *cwt.* 2 *qr.* 13 *lb.*

13. In 15 *cwt.* 3 *qr.* 14 *lb.* gross; tare 13 *lb. per cwt.* and tret 4 *lb. per* 104 *lb.* how much neat?

Ans. 13 *cwt.* 1 *qr.* 27½ *lb.*

14. Suppose 17½ *lb. per cwt.* tare, and 4 *lb. per* 104 *lb.* tret, were allowed on 7 casks of prunes, each 3 *cwt.* 1 *qr.* 5 *lb.* gross; what would be the neat weight?

Ans. 18 *cwt.* 2 *qr.* 24 *lb.*

15. What is the neat weight of 3 *hhds.* of sugar, weighing as follows: the first, 4 *cwt.* 5 *lb.* gross, tare 73 *lb.* the second, 3 *cwt.* 2 *qr.* gross, tare 56 *lb.* and the third, 2 *cwt.* 3 *qr.* 17 *lb.* gross, tare 47 *lb.* allowing also 4 *lb. per* 104 *lb.* tret? —— *Ans* 8 *cwt.* 2 *qr.* 4 *lb.*

16. In 4 casks of currants, each 7 *cwt.* 1 *qr.* 12 *lb.* gross; tare 2 *qr.* 10 *lb. per* cask, tret 4 *lb. per* 104 *lb.* and cloff 2 *lb. per* 100 *lb.* how much neat?

Ans. 25 *cwt.* 2 *qr.* 1¼ *lb.*

17. In 23 *cwt.* 3 *qr.* 7 *lb.* gross; how much neat, allowing 1 *qr.* 3 *lb. per cwt.* tare, 4 *lb. per* 104 *lb.* tret, and 2 *lb. per* 300 *lb.* cloff? — *Ans.* 16 *cwt.* 1 *qr.* 22¼ *lb.*

18. In 17 *cwt.* 17 *lb.* gross weight of galls; how much neat, allowing 18 *lb. per cwt.* tare, 4 *lb. per* 104 *lb.* tret, and 2 *lb. per* 3 *cwt.* cloff? — *Ans.* 13 *cwt.* 3 *qr.* 1½ *lb.*

19. In three casks of oil, weighing as follows: N° 1. 3 *cwt.* 17 *lb.* N° 2. 2 *cwt* 3 *qr.* 5 *lb.* N° 3. 4 *cwt.* 1 *qr.* 17 *lb.* how many gallons, allowing 18 *lb. per cwt.* tare, and 7½ *lb.* neat to a gallon? — *Ans.* 129$\frac{11}{15}$ *gal.*

20 In 7 casks of oil, each weighing 3 *cwt.* 1 *qr.* gross; how many neat gallons, allowing 20 *lb. per cwt.* tare, and 7½ *lb. per* gallon? —— *Ans.* 297$\frac{1}{15}$ *gal.*

BILLS.

BILLS OF PARCELS *and* BOOK-DEBTS, *&c.*

MR. *James Elford*,

Bought of *William Woollendraper.*

Newcastle, 2d of March, 1763,		*s.*	*d.*	
15 *yds.* of fine broad cloth	at	13	6	*per yd.*
24 —— superfine *ditto*	—	18	9	——
27 —— yard-wide *ditto*	—	8	4	——
16 —— drugget —	—	6	3	——
12 —— serge —	—	2	10	——
32 —— shalloon —	—	1	8	——

£. 53 4 10

Mr. *Nicholas Norton*, Bought of *Henry Hosier.*

London, 24th of March, 1763.		*s.*	*d.*	
9 pair of worsted stockings	at	4	6	*per* pair.
6 —— silk *ditto* ——	—	15	9	——
17 —— thread ——	—	5	4	——
23 —— cotton ——	—	4	10	——
14 —— yarn ——	—	2	4	——
18 —— women's silk gloves	—	4	2	——
19 *yds.* of flannel ——	—	1	$7\frac{1}{2}$	*per yd.*

£. 23 15 $4\frac{1}{2}$

Mr. *Matthew Milton*,

Bought of *Leonard Linendraper*, and Co.

Durham, 9th of April, 1763.		*s.*	*d.*	
40 ells of dowlas ——	at	1	6	*per* ell.
34 —— diaper ——	—	1	$4\frac{1}{2}$	——
31 —— holland ——	—	5	8	——
29 *yds* of irish cloth —	—	2	4	*per yd.*
$17\frac{1}{2}$ —— muslin ——	—	7	$2\frac{1}{2}$	——
$13\frac{1}{4}$ —— cambric ——	—	10	6	——
27 —— printed linen —	—	2	5	——

£. 34 5 $10\frac{1}{4}$

The

The *honourable* the *lady Strawberry*,

To *Miles Mercer*, Dr

York, 1763.				*s.*	*d.*	
April 12th,	$9\frac{1}{2}$ *yds* of silk	—	at	12	9 *per yd.*	
—— 27th,	13 ——	flowered *ditto*		15	6 ——	
June 18th,	$11\frac{3}{4}$ ——	lustring	—	6	10 ——	
—— ——	14 ——	brocade	—	11	3 ——	
July 22d,	$12\frac{1}{4}$ ——	sattin	——	10	8 ——	
—— 30th,	$11\frac{1}{8}$ ——	velvet	—	18	— ——	
						£. 44 15 10

Samuel Simpson, Esq; To *George Grocer*, Dr.

London, 1763.				*s.*	*d.*	
July 18th,	$15\frac{1}{2}$ *lb.* of currants	— at		-	4 *per lb.*	
—— ——	$17\frac{1}{4}$ ——	malaga raisins		-	$5\frac{1}{2}$ ——	
—— ——	$19\frac{3}{4}$ ——	raisins of the sun		-	6 ——	
Aug. 10th,	17 ——	rice	——	-	$3\frac{1}{2}$ ——	
—— 13th,	$8\frac{1}{4}$ ——	pepper	—	1	6 ——	
Sept. 14th,	3	sugar loaves, *wt.* $32\frac{1}{2}$*lb.*			$8\frac{1}{2}$ ——	
—— 21st,	13	*oz.* of cloves	——		9 *per oz.*	
						£. 3 13 — $\frac{1}{2}$

Tristram Shandy, Esq; Bought of *William Winecooper*.

6th of *May*, 1763.				*s.*	*d.*	
Palm-sack	—	12	gallons, at	8	6 *per* gal.	
Port, red	—	17	—— —	5	8 ——	
Claret	——	9	—— —	8	9 ——	
Lisbon, white	—	34	—— —	4	10 ——	
Rhenish	—	$22\frac{1}{2}$	—— —	6	4 ——	
Sherry	——	$27\frac{3}{4}$	—— —	6	2 ——	
						£. 37 15 — $\frac{1}{2}$

Mrs.

Mrs. *March* To *Mary Millener*, Dr.

					s.	d.	
1763, *Bristol.*					s.	d.	
May 3d,	Silver ribbon,	21	*yds.* at		2	2	*per yd.*
— —	Fine lace —	11½	*yds.* —		10	6	——
— 7th,	Sarcenet hoods,	8	—	—	4	3	——
June 10th,	India Fans,	17	—	—	3	10	——
—— 12th,	Kid gloves,	9	pair	—	2	2	*p.* pair.
July 6th,	Lambs ditto,	5	doz.	—	1	2	——
— 7th,	Bobbin —	12	pcs.	—	—	6	*p.* pce.

£. 18 — 11

Mr. *Roger Retail*, Bought of *Thomas Teapot* and Co.

June 3d, 1763.		s.	d.	
24¼ *lb.* of royal green tea,	at	18	6	*per lb.*
21¼ —— imperial tea,	——	24	—	——
35½ —— best bohea,	——	13	10	——
17½ —— coffee,	——	5	4	——
25 —— double refin'd sugar,		1	1½	——
9 sugar loaves, *wt.* 137 *lb.*		—	7½	——

£. 83 5 9

Capt. *James Dixon*,

Bought of *Christopher Cornchandler.*

					l.	s.	d.	
15th of *July*, 1763.					l.	s.	d.	
Wheat,	7 *qr.*	3 *bush.*	at		1	8	-	*per qr.*
Rye,	9 —	7 ——	—		1	1	6	——
Oats,	17 —	4 ——	—		-	10	8	——
Peas,	12 *bush.*	—	—		-	2	9	*per bush.*
Beans,	9 ——	—	—		-	3	5	——
Malt,	17 ——	—	—		-	4	8	——
Hops,	25 *lb.*	—	—		-	1	4	*per lb.*

£. 39 1 10¼

Mr. *Conrade Compound*, Bought of *Daniel Druggist.*

London, 17th of Aug. 1763.

				s.	d.	
Cochineal,	—	$21\frac{3}{8}$ *lb.*	at	29	6	*per lb.*
Opium,	—	$6\frac{1}{4}$	—	6	4	—
Scammony,	—	$53\frac{1}{8}$	—	8	10	—
Contrayerva,	—	$14\frac{3}{4}$	—	17	—	—
Galls,	—	93	—	—	10	—
Gum arabic	—	$71\frac{1}{8}$	—	1	$2\frac{1}{2}$	—
Saffafras,	—	122	—	—	$4\frac{1}{2}$	—

£. 80 1 $0\frac{1}{2}$

Sir *Jeffery Slingstone*, Bought of *Samuel Silversmith.*

Sept. 8th, 1763.		*oz.*	*dwt.*	*gr.*		*s.*	*d.*	
A punch-bowl,	*wt.*	23	4	—	at	5	10	*per oz.*
A tankard,	—	10	3	6	—	6	2	—
A tea-pot and lamp,		30	5	12	—	7	3	—
6 plates	—	73	11	5	—	6	1	—
18 spoons,	—	41	—	10	—	6	3	—

£. 56 1 4

Mr. *George Davis*,

Bought of *Champion Cheesemonger.*

Sept. 6, 1763.		*cwt.*	*qr.*	*lb.*		*l.*	*s.*	*d.*	
13 cheshire cheeses,	*wt.*	5	3	12	at	1	12	6	*per cwt.*
25 glocester *ditto*,	—	3	-	18	—	1	8	-	—
47 stilton *ditto*,	—	12		5	—	2	4	8	—

17 *lb.* of cream *ditto*, at $7\frac{1}{2}$*d.* *per lb.* — —

9 flitches of bacon *wt.* 53 *st.* 3 *lb.* at 4*s.* 8*d.* *per st.*

$15\frac{1}{2}$ firkins of butter, at 1*l.* 8*s.* each. — —

£. 52 - $9\frac{1}{2}$

Mr.

Mr *Timothy Tradewell,*

Bought of *Simon Screw,* 5 casks of sugar.

London, Sept. 16, 1763.

	cwt.	*q.*	*lb.*	
Nº 25.	7	3	17	tare *qr.* 3 *lb.* 14 each.
26.	8	2	11	
27.	8	-	22	
28.	7	2	5	
29.	8	1	16	
Gr.				
Tr.				
Nt.				at 2*l.* 6*s.* 8*d.* *per cwt.* £. 84 12 1

Sir *Gilbert Gosling,*

Bought of *David Jenkins,* 5 buts of oil.

Oct. 12, 1763.

	cwt.	*qr.*	*lb.*	
Nº 1.	9	3	27	tare 18 *lb. per cwt.*
2.	10	2	11	
3.	11	1	6	
4.	10	3	14	
5.	12	2	18	
Gr.				
Tr.				
Nt.				at 24*l.* 10*s.* *per* tun. £. 72 2 $5\frac{1}{4}$

Note, $7\frac{1}{2}$ *lb.* make a gallon, and 236 gallons are a tun.

SIM-

SIMPLE INTEREST.

INTEREST is the premium allowed for the loan of money.

The ſum lent is called the *principal*.

The ſum of the principal and intereſt is called the *amount*.

Intereſt is allowed at ſo much *per cent. per annum*, which premium *per cent. per annum*, or intereſt of 100 *l.* for a year, is called the *rate* of intereſt.

Intereſt is of two ſorts, *ſimple* and *compound*.

Simple intereſt is that which is allowed for the principal lent only.

Note, The rules for ſimple intereſt ſerve alſo to calculate factorage, brokage, inſurance, ſtocks, or any thing elſe rated at ſo much per cent.

RULES.

I. *To find the intereſt for a year*, multiply the principal by the rate, and divide the product by 100.

Note, When the rate is one, or can be divided into ſeveral convenient aliquot parts of 100, take the ſame part or parts of the principal for the intereſt of a year.

EXAMPLES.

1. What is the intereſt of 450 *l.* for a year at 5 *per cent. per annum*? —— —— *Anſ.* 22*l.* 10*s.*

2. What is the intereſt of 230 *l.* 10*s.* at 4 *per cent. per annum*? —— —— *Anſ.* 9*l.* 4*s.* 4*d.* $3\frac{1}{5}$*q.*

3. What is the intereſt of 715*l.* 12*s.* 6*d.* at $4\frac{1}{2}$ *per cent. per annum*? —— —— *Anſ.* 32*l.* 4*s.* $0\frac{1}{4}$*d.*

II. *To find the intereſt for ſeveral years*, multiply the intereſt of one year by the number of them.

Note, When there are ſeveral years, or ſeveral years with ſome parts of a year, it is commonly beſt to multiply them by the rate, and divide the product into aliquot parts of 100, taking the ſame parts of the principal for the anſwer.

Ex-

EXAMPLES.

1. What is the interest of 720*l.* for 3 years, at 5 *per cent. per annum?* —— —— *Ans.* 108 *l.*

2. What is the interest of 355*l.* 15*s.* for 4 years, at 4 *per cent. per annum?* —— *Ans.* 56*l.* 18*s.* 4*d.* $3\frac{1}{5}q$.

3. What is the interest of 32*l.* 5*s.* 8*d.* for 7 years, at $4\frac{1}{4}$ *per cent per annum?* —— *Ans.* 9*l.* 12*s.* $1\frac{3}{100}d$.

III. *If there be any parts of a year, as* $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, &c. the interest for them is found by taking the same parts of one year's interest, when it is not convenient to use the note in the last case.

EXAMPLES.

1. What is the interest of 170*l.* for $1\frac{1}{2}$ year, at 5 *per cent. per annum?* —— —— *Ans.* 12*l.* 15*s.*

2. What is the interest of 205*l.* 15*s.* for $\frac{1}{4}$ of a year, at 4 *per cent. per annum?* —— *Ans.* 2*l.* 1*s.* 1*d.* $3\frac{1}{5}q$.

3. What is the interest of 319*l.* 6*d.* for $5\frac{1}{4}$ years, at $3\frac{3}{4}$ *per cent. per annum?* —— *Ans.* 68*l.* 15*s.* 9*d.* $2\frac{7}{40}q$.

IV. *If there be any number of months under* 12, divide them into aliquot parts of a year, and work for them as in the last case.

EXAMPLES.

1. What is the interest of 105*l.* for 4 months, at 5 *per cent. per annum?* —— —— *Ans.* 1*l.* 15*s.*

2. What is the interest of 210*l.* 17*s.* for one year and 9 months, at $4\frac{1}{2}$ *per cent. per annum?*

Ans. 16*l.* 12*s.* $1\frac{13}{200}d$.

3. What is the interest of 312*l.* 10*s.* 4*d.* for 3 years and 8 months, at $3\frac{1}{4}$ *per cent. per annum?*

Ans. 37*l.* 4*s.* 9*d.* $3\frac{68}{75}q$.

V. *For any number of weeks,* if they be no part or parts of 52, multiply the interest of a year by them and divide by 52.

And for any number of days, multiply the interest of a year by them and divide by 365.

A

A TABLE *shewing the number of days from any day of one month to the same day of any other month.*

To \ From	Jan.	Feb.	Ma.	Ap.	May	Jun.	July	Au.	Sep.	Oct.	No.	De.
Jan.	365	334	306	275	245	214	184	153	122	92	61	31
Feb.	31	365	337	306	276	245	215	184	153	123	92	62
Mar.	59	28	365	334	304	273	243	212	181	151	120	90
Apr.	90	59	31	365	335	304	274	243	212	182	151	121
May	120	89	61	30	365	334	304	273	242	212	181	151
June	151	120	92	61	31	365	335	304	273	243	212	182
July	181	150	122	91	61	30	365	334	303	273	242	212
Aug.	212	181	153	122	92	61	31	365	334	304	273	243
Sept.	243	212	184	153	123	92	62	31	365	335	304	274
Oct.	273	242	214	183	153	122	92	61	30	365	334	304
Nov.	304	273	245	214	184	153	123	92	61	31	365	335
Dec.	334	303	275	244	214	183	153	122	91	61	30	365

Note, In leap year, if the end of the month of february be in the time, one day more must be added on that account.

EXAMPLES.

1. What is the interest of 300*l.* for 14 weeks, at 5 *per cent. per annum?* —— —— *Ans.* 4*l.* $9\frac{3}{13}$*d.*

2. What is the interest of 212*l.* for 2 years 17 weeks, at 4 *per cent. per annum?* — *Ans.* 19*l.* 14*s.* 7*d.* $3\frac{1}{65}$*q.*

3. What is the interest of 107*l.* for 117 days, at $4\frac{3}{4}$ *per cent. per annum?* —— *Ans.* 1*l.* 12*s.* $7\frac{8}{1825}$*d.*

4. What is the amount of 120*l.* from jan. 7, to sept. 12, 1763, at 4 *per cent per annum?*

Ans. 123*l.* 5*s.* 2*d.* $2\frac{134}{165}$*q.*

5. What

5. What is the intereſt of 213*l.* from feb. 12, to june 5, 1764, it being leap year, at $3\frac{1}{2}$ *per cent per annum?*

Anſ. 2*l.* 6*s.* 6*d.* $3\frac{501}{1825}$*q.*

N. B. The following neat and conciſe table and method for working ſimple intereſt for any number of days, at any rate of intereſt, is taken from the *gentleman's diary*, I having only continued the table into decimal numbers.

Numb.	*l.*	*s.*	*d.*	*q.*	Nu.	*l.*	*s.*	*d.*	*q.*	Nu.	*l.*	*s.*	*d.*	*q.*
1000000	2739	14	6	0·99	3000	8	4	4	2·41	5	0	0	3	1·15
900000	2465	15	0	3·29	2000	5	9	7	0·27	4	0	0	2	2·52
800000	2191	15	7	1·59	1000	2	14	9	2·14	3	0	0	1	3·89
700000	1917	16	1	3·89	900	2	9	8	3·12	2	0	0	1	1·26
600000	1643	16	8	2·19	800	2	3	10	0·11	1	0	0	0	2·63
500000	1369	17	3	0·49	700	1	18	4	1·10	0·9	0	0	0	2·37
400000	1095	17	9	2·79	600	1	12	10	2·08	0·8	0	0	0	2·10
300000	821	18	4	1·10	500	1	7	4	3·07	0.7	0	0	0	1·84
200000	547	18	10	3·40	400	1	1	11	0·05	0·6	0	0	0	1·58
100000	273	19	5	1·70	300	0	16	5	1·04	0·5	0	0	0	1·32
90000	2 6	11	6	0·33	200	0	10	11	2·03	0·4	0	0	0	1·05
80000	219	3	6	2·96	100	0	5	5	3·01	0·3	0	0	0	0·79
70000	191	15	7	1·59	90	0	4	11	0·71	0 2	0	0	0	0·53
60000	164	7	8	0·22	80	0	4	4	2·41	0·1	0	0	0	0·26
50000	136	19	8	2·85	70	0	3	10	0·11	0·09	0	0	0	0·24
40000	109	11	9	1·48	60	0	3	3	1·81	0·08	0	0	0	0·21
30000	82	3	10	0·11	50	0	2	8	3·51	0·07	0	0	0	0·18
20000	54	15	10	2·74	40	0	2	2	1·21	0·06	0	0	0	0·16
10000	27	7	11	1·37	30	0	1	7	2·90	0·05	0	0	0	0·13
9000	24	13	1	3·23	20	0	1	1	0·60	0·04	0	0	0	0·11
8000	21	18	4	1·10	10	0	0	6	2·30	0·03	0	0	0	0·08
7000	19	3	6	2·96	9	0	0	5	3·67	0·02	0	0	0	0·05
6000	16	8	9	0·82	8	0	0	5	1·04	0·01	0	0	0	0·03
5000	13	13	11	2·68	7	0	0	4	2·41					
4000	10	19	2	0·55	6	0	0	3	3·78					

RULE.

Multiply the principal by the rate, both in pounds; multiply the product by the number of days, and divide this laſt product by 100; then take from the table the ſeveral ſums which ſtand oppoſite the ſeveral parts of the quotient, and adding them together will give the intereſt required.

EX-

EXAMPLES.

1. What is the interest of 225*l.* 10*s.* for 23 days, at $4\frac{1}{2}$ *per cent. per annum?*

Then in the table

					l.	*s.*	*d.*	*q.*
princ. 225·5								
rate 4·5	*against*	200	is		0	10	11	2·03
		30	—		0	1	7	2·90
1014·75		3	—		0	0	1	3·89
days 23		0·3	—		0	0	0	0·79
		0 09	—		0	0	0	0·24
100)23339·25								
	Ans.				0	12	9	1·85 *true in*
233·39225	*the last place of decimals.*							

2. What is the interest of 17*l.* 5*s.* for 117 days, at $4\frac{1}{4}$ *per cent. per annum?* —— *Ans.* 5*s.* 3*d.* 0·12*q.*

3. What is the interest of 112*l.* 12*s.* 6*d.* from the 8th of may, to the 3d of november, at 4 *per cent. per annum?*

Ans. 2*l.* 4*s.* 2*d.* 0·92*q.*

QUESTIONS

Concerning *brokerage*, *factorage*, *insurance*, and *Stocks*.

Brokerage is the allowance made to brokers for assisting others in buying or disposing of their goods.

Factorage, *provision*, or *commission* is an allowance made to factors or agents beyond sea, for buying or selling of goods for their employers.

Insurance is security given, in consideration of a premium paid down, to restore, to a certain value for which the premium is advanced, the loss or damage on ships, houses, goods, &c. by storms, fire, &c. But in the calculations, the word *insurance* is commonly wrote for premium.

Stocks are the public funds of the nation; the shares of which being transferable from one person to another, occasion the extensive business, or worst kind of gaming, called stock-jobbing.

EXAMPLES.

1. What is the brokage of 610 *l.* at 5*s.* or $\frac{1}{4}$ *per cent?*

Ans. 1*l.* 10*s.* 6*d.*

2. What is the brokage of 372*l.* 7*s.* 4*d* at 4*s.* 6*d. per cent?* —— —— —— *Anſ.* 16*s.* $9\frac{19}{250}$*d.*

3. What is the factorage of 920*l.* at $3\frac{1}{2}$ *per cent?*
Anſ. 32*l.* 4*s.*

4. What is the commiſſion of 508*l.* 17*s.* 10*d.* at $1\frac{1}{2}$ *per cent?* —— —— *Anſ.* 7*l.* 12*s.* $8\frac{1}{100}$*d.*

5. What is the inſurance of 900*l.* at $10\frac{3}{4}$ *per cent?*
Anſ. 96*l.* 15*s.*

6. What is the inſurance of 712*l.* 6*s.* for 8 months, at $7\frac{1}{2}$ *per cent. per annum?* —. *Anſ.* 35*l.* 12*s.* 3*d* $2\frac{2}{5}$*q.*

7. What is the purchaſe of 1200*l.* ſouth-ſea ſtock at $103\frac{5}{8}$ *per cent?* —— —— *Anſ.* 1243*l.* 10*s.*

8. What is the purchaſe of 912*l.* 14*s.* bank ſtock, at $127\frac{3}{4}$ *per cent?* —— *Anſ.* 1165*l* 19*s.* 5*d.* $3\frac{7}{25}$*q.*

9. What is the purchaſe of 2380*l.* india ſtock, at $147\frac{1}{4}$ *per cent?* —— —— —— *Anſ* 3504*l.* 11*s.*

10 What is the purchaſe of 816*l.* 12*s.* bank annuities, at $89\frac{3}{8}$ *per cent?* —— *Anſ.* 729*l.* 16*s.* 8*d.* $2\frac{4}{5}$*q.*

COMPOUND INTEREST.

COMPOUND intereſt is that which is allowed, not only for the ſum lent, but alſo for its intereſt as it becomes due at the end of each ſtated time of payment.

RULES.

I. Find the amount of the given principal for the time of the firſt payment, by ſimple intereſt; then conſider this amount as the principal for the ſecond payment, whoſe amount calculate in the ſame manner; and ſo on through all the payments, ſtill accounting the laſt amount as the principal of the next payment. *Or,*

II. Find the amount of one pound for the time of the firſt payment, and multiply it by itſelf ſo often as are the number of payments wanting 1, that is, twice by itſelf if there be three payments, thrice if there be four, &c. then the laſt product multiplied by the principal gives the whole amount.

Note, It is not necessary that the payments should be yearly, for the rule will hold whether they be yearly, half yearly, quarterly, monthly, or any other aliquot part of a year; but there must be a complete integer number of the times of payments, not a certain number of times and part of another, for the rule takes no notice of such parts, nor will it be just to calculate for a complete time and take the same part of the result as is the part of the time; but in this manner has Shepherd falsely calculated some of his examples. It is possible to perform all such calculations, both parts of times and whole ones, without logarithms, though the trouble is, in some cases, intolerable: but by the logarithms it is as easy to perform the calculations with parts of times of payments, as with whole ones.

EXAMPLES.

1. What will 50*l* amount to in 5 years, at 5 *per cent. per annum*, compound interest? — *Ans.* 63*l.* 16*s.* 3¼*d.*

2. What will 50*l.* supposing the interest payable half-yearly, amount to in 5 years, or 10 half-years, at 5 *per cent. per annum*, compound interest? — *Ans.* 64*l.* 1*d.*

3. What will 50*l.* the interest payable quarterly, amount to in 5 years, at 5 *per cent. per annum*, compound interest? *Ans.* 64*l.* 2*s.* 0¼*d.*

4. What is the compound interest of 370*l.* forborn 6 years, at 4 *per cent per annum*? — *Ans.* 98*l.* 3*s.* 4¼*d.*

5. What is the compound interest of 410*l.* forborn 2½ years, at 4½ *per cent. per annum*, supposing the interest payable half-yearly? —— *Ans.* 48*l.* 4*s.* 11¼*d.*

6. What is the amount of 217*l.* forborn 2¼ years, at 5 *per cent. per annum*, supposing the interest payable quarterly? —— —— *Ans.* 242*l.* 13*s.* 4½*d.*

REBATE or DISCOUNT.

REBATE or *discount*, is the difference between a sum of money due at a certain time to come, and its present worth.

The *present worth* of any sum or debt, due some time hence, is such a sum, as if put to interest, would, in the time and at the rate for which the discount is to be made, amount to the sum or debt then due.

RULE.

RULE.

As the amount of 100*l.* for the given rate and time,
Is to 100*l.* or the intereſt of 100*l.* for the given time;
So is the given ſum or debt,
To the preſent worth, or diſcount of the given ſum.

Note 1. The meaning of four things wrote in the form above, is that they are the four terms of a rule of three queſtion.

2. "The method uſed among bankers, &c. in diſcounting bills, is to find the intereſt of the ſum drawn for, from the time the bill is diſcounted to the time when it becomes due, (including the days of grace) which intereſt they reckon as the diſcount, thereby making the diſcount more than it really is."

But when goods are bought or ſold, and diſcount is to be made for preſent payment, at any rate per cent. without regard to time, the intereſt of the ſum as calculated for a year is the diſcount.

EXAMPLES.

1. What is the preſent worth of 700*l.* due 9 months hence, diſcount at 5 *per cent. per annum*?

Anſ. 674*l.* 13*s.* 11*d.* $2\frac{70}{83}$*q.*

2. What is the diſcount of 312*l* for 6 months, at 6 *per cent per annum*? — *Anſ.* 9*l.* 1*s.* 8*d* $3\frac{91}{103}$*q.*

3. What is the rebate of 125*l.* 10*s.* payable 10 months hence, at $4\frac{1}{2}$ *per cent. per annum*?

Anſ 4*l.* 10*s.* 8*d.* $2\frac{58}{83}$*q.*

4. What is 217*l.* 4*s.* 6*d.* due 5 months hence, worth in preſent money, diſcount at $5\frac{1}{2}$ *per cent*?

Anſ. 212*l.* 7*s.* $2\frac{14}{491}$*d.*

5. How much ready money for a note of 73*l.* due 17 months hence, diſcount at 5 *per cent. per annum*?

Anſ. 68*l.* 3*s.* $5\frac{23}{257}$*d.*

6. Sold goods to the amount of 83*l.* 6*s.* to be paid 6 months hence; what muſt I have in preſent money, diſcount at 8 *per cent. per annum*? — *Anſ.* 80*l.* 1*s.* $11\frac{1}{13}$*d.*

7. Bought goods to the value of 35*l.* 8*s.* to be paid 8 months hence; what muſt I pay in preſent money, diſcount at 7 *per cent. per annum*? *Anſ.* 33*l.* 16*s.* $5\frac{31}{157}$*d.*

8. If a legacy of 600*l.* is left me on the 3d of may, 1763, to be paid on the chriſtmas-day following; what

muſt I receive, when I allow 5 *per cent. per annum* diſcount for preſent payment? *Anſ.* 581*l.* 4*s.* 2*d.* 1$\frac{123}{157}$*q.*

9. What is the preſent worth of 60*l* payable at two 3 months, at 5 *per cent. per annum* diſcount?

Anſ. 58*l.* 17*s.* 11*d.* 2$\frac{2}{3061}$*q.*

10. What is the preſent worth of 120*l.* payable as follows, *viz.* 50*l.* at 3 months, 50*l.* at 5 months, and the reſt at 8 months, diſcount at 6 *per cent. per annum*?

Anſ. 117*l.* 5*s.* 5$\frac{1}{4}$*d.*

EQUATION OF PAYMENTS.

EQUATION of payments is the finding a time, when if a ſum of money be paid which is equal to the ſum of ſeveral others due at different times, no loſs will be ſuſtained by either party.

*The * common rule is to*

Multiply each payment by the time it is due at, then dividing the ſum of the products by the ſum of the payments, the quotient is the equated time.

EXAMPLES.

1. There is a debt of 60*l.* to be paid 30*l.* at 2 months, and

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* The only true rule is this:

If p be the firſt payment, and t the time till it be due; alſo $P =$ any other payment, and $T =$ its time; moreover if r be one year's intereſt of 1*l.* put $a = T + t + \frac{P+p}{pr}$, and $c = Tt + \frac{PT+pt}{pr}$;

then $\frac{a \pm \sqrt{a^2 - 4c}}{2}$ is the equated time for theſe two payments then by the ſame rule an equated time may be found for this and a third payment, &c.

This rule is the ingenious Mr. *Malcolm*'s: *Kerſey*'s rule, which *Dilworth* has given in pag. 143 of his *Schoolmaſter*'s *aſſiſtant* as the true method of working equation of payments, is falſe.

and 30*l.* at 4 months; but if it be reduced to one payment, at what time must it be made?—*Ans.* at 3 *months.*

2. A debt of 120*l.* due as follows, *viz.* 50*l.* at 2 months, 40*l.* at 5 months, and the rest at 7 months: when must the whole be paid? —— *Ans.* at $4\frac{1}{4}$ *mo.*

3. A debt of 500*l.* is to be discharged thus, *viz.* 100*l.* present; 300*l.* at 4 months, and the rest at 6 months: what is the equated time for the whole? — *Ans.* $3\frac{1}{5}$ *mo.*

4. A debt is to be discharged by paying $\frac{1}{2}$ at 3 months, $\frac{1}{3}$ at 5 months, and the rest at 6 months: what is the equated time for the whole? —— *Ans.* $4\frac{1}{6}$ *mo.*

5. A debt is to be discharged thus, *viz.* $\frac{1}{4}$ present, and $\frac{1}{4}$ every 3 months after, till the whole be discharged: what is the equated time for the whole? — *Ans.* $4\frac{1}{2}$ *mo.*

SINGLE FELLOWSHIP.

SINGLE Fellowship is a rule by which any number may be divided into any assigned number of parts, which shall be proportional to so many other proposed numbers, each to each.

By this rule are adjusted the gain or loss or charges of merchants in company, the effects of bankrupts, legacies in case of a deficiency of assets, *&c.*

RULE.

Make the sum of the numbers, to which the required parts must be proportional, the first term; the number to be parted or divided, the second; and each of the given numbers, to which the required ones must be proportional, the several third terms of so many rule-of-three questions; the fourth terms of which will be the respective parts required.

Note 1. The first and third contractions of the rule-of-three are the best for working questions in this rule; because the two first terms of all the statings being the same, there will be had a constant multiplier or divisor for the third terms.

 2. When

2. When two or more of the terms, to which the required ones must be proportional, are equal; so many operations will be saved as there are equalities.*

EXAMPLES.

1. Divide the number 120 into 3 such parts as shall be to each other as 1, 2, and 3. — *Ans.* 20, 40, *and* 60.

2. Two merchants, *A* and *B* trade together; *A* puts into the stock 60*l.* and *B* puts in 40*l.* and gain by trading 24*l.* what are their shares of it?

Ans. A's *share is* 14*l.* 8*s.* *and* B's 9*l.* 12*s.*

3. Two merchants, *C* and *D*, made a stock of 120*l.* whereof *C* contributed 75*l.* by trading they lost 30*l.* what must each sustain of it?—*Ans.* C 18*l.* 15*s.* *and* D 11*l.* 5*s.*

4. Three merchants, whose stock is 700*l.* whereof *E* contributed 123*l.* *F* 358*l.* and *G* the rest, gain by trading 125*l.* 10*s.* what must each have of it?

Ans. E *must have*		22*l.*	1*s.*	0*d.*	$2\frac{2}{35}$*q.*
F	—	64	3	8	$0\frac{32}{35}$
G	—	39	5	3	$1\frac{1}{35}$

5. Three merchants, *H*, *I*, and *K*, freighted a ship with 340 tuns of wine, whereof *H* loaded 110 tuns, *I* 97, and *K* the rest; in a storm the seamen were obliged to throw overboard 85 tuns: how much must each sustain of the loss? — *Ans.* H $27\frac{1}{2}$, I $24\frac{1}{4}$, *and* K $33\frac{1}{4}$ *tuns.*

6. A

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* A question in this rule may be proposed and solved in a general manner thus:

To divide the number *n* into *p* parts, which shall be as the numbers *a*, *b*, *c*, &c.

Solution.

$$a+b+c+\&c.:n::\left\{\begin{array}{l} a:\dfrac{an}{a+b+c+\&c.} \\ b:\dfrac{bn}{a+b+c+\&c.} \\ c:\dfrac{cn}{a+b+c+\&c.} \\ \&c.\ \&c. \end{array}\right.$$

6. A piece of ground, consisting of 37 *ac.* 2 *ro.* 14 *ps.* is to be divided among three persons, *L*, *M*, and *N*, in proportion to their estates: now if *L*'s estate be worth 500*l.* a year, *M*'s 320*l.* and *N*'s 75*l.* what quantity of land must each one have?

Ans. L *must have*	20 *ac.*	3 *ro.*	$39\frac{139}{179}$ *ps.*	
M ——	13	1	$30\frac{46}{179}$.	
N ——	3	-	$23\frac{173}{179}$.	

7. A person is indebted to *O* 57*l.* 15*s.* to *P* 108*l.* 3*s.* 8*d.* to *Q* 22*l.* 10*d.* and to *R* 73*l.* but at his decease, his effects are found to be worth no more than 170*l.* 14*s.* how must it be divided among his creditors?

Ans. O *must have*	37*l.*	15*s.*	5*d.*	$2\frac{5302}{10439}$ *q.*
P ——	70	15	2	$2\frac{7498}{10439}$.
Q ——	14	8	4	$0\frac{4720}{10439}$.
R ——	47	14	11	$2\frac{3358}{10439}$.

8. A ship worth 900*l.* being entirely lost, of which $\frac{1}{8}$ belonged to *S*, $\frac{1}{4}$ to *T*, and the rest to *V*; what loss will each sustain, supposing 540*l.* of her were insured?

Ans. S *will lose* 45*l.* T 90*l.* *and* V. 225*l.*

9. Four persons, *W*, *X*, *Y*, and *Z*, spent among them 25*s.* and agree that *W* shall pay $\frac{1}{2}$ of it, *X* $\frac{1}{3}$, *Y* $\frac{1}{4}$ and *Z* $\frac{1}{5}$; that is, their shares are to be in proportion as $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{5}$; what are their shares?

Ans. W *must pay*	9*s.*	8*d.*	$3\frac{41}{77}$ *q.*
X ——	6	5	$3\frac{53}{77}$.
Y ——	4	10	$1\frac{59}{77}$.
Z ——	3	10	$3\frac{1}{77}$.

DOUBLE FELLOWSHIP.

WHEN the shares of partners are continued in company unequal times, they occasion the name *fellowship with time, or double fellowship*: which is performed by the following

RULE.

RULE.*

Multiply each ſhare by the time of its continuance; then divide the gain or loſs in proportion to the products, as in ſingle fellowſhip, by ſaying, As the ſum of the products is to the whole gain or loſs, ſo is each product, to each part of it.

EXAMPLES.

1. *A* had in company 50*l.* for 4 months, and *B* 60*l.* for 5 months: at the end of which they find 24*l.* gained: how muſt it be divided between them?

Anſ. A *muſt have* 9*l.* 12*s* *and* B 14*l* 8*s.*

2. A ſhip's company take a prize of 1000*l.* which they agree to divide among them according to their pay and the time they have been on board: now the officers and midſhipmen have been on board 6 months, and the ſailors 3 months; the officers have 40*s.* a month, the midſhipmen 30*s.* and the ſailors 22*s.* a month; moreover there are 4 officers, 12 midſhipmen, and 110 ſailors: what will each man's ſhare be?

Anſ. each officer muſt have	23*l.*	2*s.*	5*d.*	$0\frac{92}{113}$ *q.*
— *midſhip.* ——	17	6	9	$3\frac{69}{113}$.
— *ſeaman* ——	6	7	2	$0\frac{8}{113}$.

3. *A*, *B*, and *C*, have a paſture in common, for which they pay 30*l.* *per annum*; into which *A* put 7 cows for 3 months, *B* 9 cows for 5 months, and *C* 4 cows for 12 months: what muſt each pay of the rent?

Anſ. A *muſt pay*	5*l.*	10*s.*	6*d.*	$1\frac{5}{19}$ *q.*
B ——	11	16	10	$0\frac{8}{19}$.
C ——	12	12	7	$2\frac{6}{19}$.

4. X,

* Mr. Ward has given an analytical inveſtigation of this rule, and Mr. Malcolm has given the reaſon of it in a manner evident enough; but I think the moſt general and elegant manner of proof is thus:

When the times are equal, the ſhares of the gain or loſs are evidently as the ſtocks, as in ſingle fellowſhip; and when the ſtocks are equal, the ſhares are as the times; wherefore when neither are equal, the ſhares muſt be as their products.

4. *X*, *Y*, and *Z* made a joint ſtock, for 12 months: *X* at firſt put in 20*l*. and 4 months after 20*l*. more; *Y* put in at firſt 30*l*. at the end of 3 months he put in 20*l*. more, and 2 months after he put in 40*l*. more; *Z* put in at firſt 60*l*. and 5 months after he put in 10*l*. more, 1 month after which he took out 30*l*. during the 12 months they gained 50*l*. how much of it muſt each have?

Anſ. X *muſt have*	10*l*.	18*s*.	6*d*.	$3\frac{49}{61}$ q.
Y ——	22	8	1	$0\frac{12}{61}$.
Z ——	16	13	4	—.

BARTER.

BARTERING is the exchanging of commodities; and as neither party is ſuppoſed to ſuſtain any loſs, when the commodities exchanged are not of equal value, the defect is ſupplied with money, *&c*.

CASE I.

When the quantity of one commodity is given, with its value, or that of its integer; as alſo the value of the integer, or rate of ſelling ſome other commodity to be given for it, to find the quantity of this; or having the quantity of the latter given to find the rate of ſelling it.

If the amount of the given quantity be unknown, calculate it in the ſhorteſt manner you can, from the given value of its integer; then find how much of the other quantity this amount will purchaſe, at the given rate of ſelling it; or if the quantity be given, from thence find the rate of ſelling it.

CASE II.

If the quantities of both commodities, with the rate of ſelling them be given; to find what quantity of ſome other commodity or money muſt be given in caſe of an inequality of the amounts of the firſt commodities.

Calculate the amount of each of the two given commodities; then their difference is the money, or amount of the third commodity to be advanced: whoſe quantity, from thence and its rate, is eaſily found.

CASE

CASE III.

When, in bartering, one commodity is rated above the ready-money price; to find the quantity and bartering price of the other commodity.

Say, As the ready-money price of the one, is to its bartering price, so is that of the other to its barter price; then the quantity of the latter commodity may be found either from the ready money or bartering prices.

Note; These are the most general cases in barter, and such questions as are not contained in them, are easily solved from a little consideration of their nature.

EXAMPLES.

1 How much tobacco at 1*l.* 16*s.* *per cwt.* must be given for 3 pipes of wine at 28*l.* 10*s.* *per* pipe?

Ans. 47 *c.* 2 *qr.*

2. How much cloth at 14*s.* 6*d.* *per* yard, must be given for 3 *cwt.* 3 *qr.* of sugar at 3*l.* 4*s.* *per cwt?*

Ans. 16 *yds.* $2\frac{6}{29}$ *qr.*

3. What weight of hops at 1*l.* 12*s.* *per cwt.* must be given for 14 *cwt.* 1 *qr.* 18 *lb.* of cheese at 1*l.* 6*s.* *per cwt?*

Ans. 11 *c.* 2 *qr.* $23\frac{1}{8}$ *lb.*

4. If 24 yards of cloth be given for 5 *cwt.* 1 *qr.* of tobacco, at 1*l.* 18*s.* *per cwt.* what is the cloth rated at *per* yard? —— —— —— *Ans.* 8*s.* $3\frac{1}{4}$*d.*

5. *A* and *B* would barter: *A* hath 40 yards of cloth at 7*s.* 4*d.* *per* yard, *B* has $28\frac{1}{2}$ *lb.* of tea, at 11*s.* 6*d.* *per* *lb* whether must pay ballance, and how much?

Ans. A *must pay* 1*l.* 14*s.* 5*d.*

6. *C* and *D* would barter: *C* has 53 quarters, 5 bush. of corn, at 1*l.* 10*s.* *per* quarter; for which *D* would give 13 *cwt.* 16 *lb.* of sugar, at 4*l.* 12*s.* *per cwt.* and the ballance in raisins, at $6\frac{1}{2}$*d.* *per lb.* how many *lb* of raisins must be given? —— —— *Ans.* $737\frac{67}{91}$ *lb.*

7. *E* and *F* barter: *E* gives to *F* 90 gallons of brandy, at 7*s.* 8*d.* *per* gallon; for which *F* gives to *E* 10 guineas in money, and 500*lb.* of cotton; what is it valued at *per lb.* —— —— —— *Ans.* 11*d* $2\frac{2}{25}$*q.*

8. *G* and *H* bartered: *G* had 13 *cwt.* 5 *lb.* of sugar, worth 1*l.* 15*s.* *per cwt.* but bartered it with *H*, at

2*l.* 4*s.*

2*l.* 4*s. per cwt.* for wine worth 4*s.* 8*d. per* gallon: what was the barter price of the wine, and how much of it was given for the ſugar?

Anſ. 5*s.* $10\frac{2}{5}$*d.* per *gal. and* $97\frac{187}{224}$*gal. equal the ſugar.*

9. *K* and *L* barter: *K* has woollen cloth worth 8*s. per* yard, which he barters at 9*s.* 3*d.* with *L*, for linen cloth at 3*s. per* yard, which is worth only 2*s.* 7*d. per* yard: whether has the advantage in barter, and how much linen does *L* give *K* for 70 yards of woollen?—*Anſ.* $215\frac{5}{6}$ *yds. of linen; and* L *has the advantage, his proportional barter price being only* 2*s.* 11*d.* $3\frac{3}{8}$*q.*

LOSS *and* GAIN.

QUESTIONS in this rule are ſuch whoſe ſolutions determine the *loſs* or *gain* upon commodities; of which queſtions there are great variety; but may be eaſily ſolved from a little conſideration and the following proportion, *viz.* That the *gains* or *loſſes* are in proportion as their *quantities*, and the contrary.

EXAMPLES.

1. Bought 5*c.* 3*qr.* 14*lb.* of cheeſe, at 1*l.* 12*s. per cwt.* and ſold it again for 2*l.* 8*d. per cwt.* what was the gain upon the whole? —— *Anſ.* 2*l.* 10*s.* 11*d.*

2. If 5*c.* 3*qr.* 14*lb.* be bought for 9*l.* 8*s.* and ſold for 11*l.* 18*s.* 11*d.* what is the rate of gain *per cwt?*

Anſ. 8*s.* 8*d.*

3. If 8*c.* 18*lb.* be bought for 45*l.* at what rate *per lb.* ſhall I ſell it to gain 10*l.* upon the whole?

Anſ. 1*s.* 2*d.* $1\frac{351}{457}$*q.*

4. If 8*c.* 18*lb.* coſt 45*l.* at what rate *per lb.* muſt it be ſold, that the loſs upon the whole may be 10*l?*

Anſ. $9\frac{87}{457}$*d.*

5. Bought hops at 4*l.* 16*s. per cwt.* at what rate *per cwt.* muſt I ſell them to gain 15*l. per cent?*

Anſ. 5*l.* 10*s.* 4*d.* $3\frac{1}{5}$*q.*

6. Bought hops at 4*l.* 16*s. per cwt.* at what rate *per cwt.* muſt I ſell them, to loſe 15*l. per cent?*

Anſ. 4*l.* 1*s.* $7\frac{1}{5}$*d.*

7. * If, when I ſell cloth at 7*s*. *per* yard, I gain 10*l*. *per cent*. what will be the gain *per cent*. when it is ſold for 8*s*. 6*d*. *per* yard? —— *Anſ*. 33*l*. 11*s*. $5\frac{1}{7}$*d*.

8. If, when I ſell cloth at 7*s*. a yard, I gain 10*l*. *per cent*. what is the gain or loſs *per cent*. when it is ſold at 6*s*. a yard? —— —— *Anſ*. 5*l*. 14*s*. $3\frac{3}{7}$*d*. *loſs*.

9. If, when I ſell ſugar at 8*s*. 6*d* a ſtone, I loſe 5*l*. *per cent*. what do I gain or loſe *per cent*. when I ſell it for 9*s*. a ſtone? —— —— *Anſ*. 11*s*. $9\frac{3}{17}$*d*. *gain*.

10. Bought for 17*s*. 8*d*. and ſold for 18*s*. 4*d*. what was the gain *per cent?* —— *Anſ*. 3*l* 15*s*. 5*d*. $2\frac{34}{53}$*q*.

11. Bought 12 yards of cloth for 5*l*. 9*s*. and ſold them again at 9*s*. 6*d*. a yard: what was the gain or loſs *per cent?* —— —— *Anſ*. 4*l*. 11*s*. 8*d*. $3\frac{73}{109}$*q*. *gain*.

12. At $1\frac{1}{2}$*d*. *per* ſhilling profit, how much *per cent?*
Anſ. 12*l*. 10*s*.

13. At 3*s*. 6*d*. to the pound profit, how much *per cent?* —— —— —— *Anſ*. 17*l*. 10*s*.

14. Having ſold 12 yards of cloth for 5*l*. 14*s*. and thereby gained 8*l*. *per cent*. what was the prime coſt of a yard? —— —— *Anſ*. 8*s*. 9*d*. $2\frac{2}{9}$*q*.

EX-

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* Queſtions of this ſort are ſeldom rightly underſtood, or ſolved: thus, the queſtion beginning at the 7th line of page 33 of the 4th edition of Webſter's arithmetic is wrong, the true anſwer being 35 l. and not 10 l. And in the ſame manner has Stonehouſe falſely ſolved the 2d example in page 89 of the 3d edition of his arithmetic, the anſwer to which queſtion ſhould be 23 l. 12 s. 6 d. and not 8 l. 12 s. 6 d. Alſo in a manner ſimilar to theſe has Dilworth falſely calculated his 7th example in loſs and gain, making the anſwer 2 l. 16 s. 3 d. inſtead of 3 l. 1 s. $9\frac{3}{4}$ d. though this queſtion has Lowe copied into his book of arithmetic with the falſe anſwer; as he has done ſeveral others from different authors, whereof one is from Malcolm, who brought out his anſwer wrong, not by a falſe method of ſolution, but by ſome wrong figures ſlipping from his pen in the proceſs, or in the propoſition. Hill has alſo run into the ſame miſtake.——The error conſiſts in making the gain or loſs of 100 l. the 2d term of the queſtion inſtead of its amount.

EXCHANGE.

BY exchange is meant the bartering or exchanging of the money of one place for that of another; and, like the bartering of wares, it commonly consists in finding what quantity of the money of one place will be equal to a given sum of another, according to a given course of exchange.

By *course* of exchange is meant the variable sum of the money of one place which is proposed to be given for a constant piece or sum of that of another, to serve for the present, as a rate or proportion by which to exchange other sums, and is sometimes above and sometimes below the *par*.

By the *par* of exchange is meant an intrinsic equality between two pieces or sums of money, one of which is the constant piece or sum to which the course is compared.

The money in the banks of foreign places is finer or purer than that which is current in them; and the difference between any sum as valued in the one and its value in the other, is called *agio*.

Note, it is by comparing the bank money with ours that the par is ascertained. Also the exchange is always supposed to be made in bank money; and if there be a necessity for taking currency in case of a defect of the bank to answer the bills, the more of it must be received, and that in proportion to the agio.

I. *With* IRELAND, AMERICA, *and the* WEST-INDIES.

Accounts are kept in Ireland, America, and the West-Indies in pounds, shillings, and pence, as in England; and exchange *per cent.* sterling; the *par* being 108*l.* 6*s.* 8*d.* irish *per* 100*l.* sterling, or 1*l.* 1*s.* 8*d.* *per* pound: also 5*l.* sterling is accounted worth 7*l.* of the cerrency of the West-indies, because of the great plenty of foreign coins there; but on the continent of America there is very little coin of any sort circulating.

EXAMPLES.

1. London remits to Dublin 375*l.* 15*s.* what must be received there, exchange at 110 *per cent?*

Ans. 413*l.* 6*s.* 6*d.*

2. Dublin remits to London 413*l.* 6*s.* 6*d.* what must be received there, exchange at 110 *per cent?*

Ans. 375*l.* 15*s.*

3. London remits to Jamaica for 212*l.* 12*s* 6*d.* ſterling: what muſt be received for it, exchange at 135 *per cent?* —— —— *Anſ.* 287*l.* 10½*d.*

4. Jamaica remits to London for 287*l.* 10½*d.* currency: what muſt be received for it, exchange at 135 *per cent?*
Anſ. 212*l.* 12*s.* 6*d.*

II. *With* HOLLAND, FLANDERS, *and* GERMANY.

In theſe places accounts are kept, ſometimes in pounds, ſhillings, and pence, as in England; and ſometimes in guilders, ſtivers, and pennings; the money of *Holland* and *Flanders* is diſtinguiſhed by the name *flemiſh*, and they exchange by the *l.* ſterling, the *par* being 33*s.* 4d. flemiſh *per* pound ſterling.

Note,	8 pennings — 1 grote or penny.
16 pennnings — 1 ſtiver.	12 grotes or pence — 1 ſkilling.
20 ſtivers — 1 guilder or florin.	20 ſkillings — 1 pound.
And in Germany,	6 phennings — 1 grote flem.
12 phennings — 1 ſhilling lubs.	6 lubiſh ſhill. — 1 ſkill. flem.
16 lubiſh ſhillings — 1 mark.	7½ marks lubs — 1 pound flem.

EXAMPLES.

1. To how much flemiſh will 700*l.* ſterling amount, exchange at 34*s.* flem. *per l.* ſter? — *Anſ.* 1190*l.*

2. To how much ſterling will 1190*l.* flemiſh amount, exchange at 34*s.* *per l.* ſter? —— *Anſ.* 700*l.*

3. How much flemiſh muſt be given for 314*l.* 5*s.* ſterling, exchange at 33*s.* 8*d.* flem. *per l.* ſter?
Anſ. 528*l.* 19*s.* 9*d.*

4. How much ſterling muſt be given for 528*l.* 19*s.* 9*d.* flem. exchange at 33*s.* 8*d.* *per l.* ſter?
Anſ. 314*l.* 5*s.*

5. How many guilders may I have for 173*l.* 14*s.* 2*d.* ſter. exchange at 35*s.* 3½*d.* flem. *per l.* ſter?
Anſ. 1839 *gu.* 2 *ſt.* 11⅝ *pen.*

6. How much ſterling muſt I have for 2714 *guil.* 15 *ſt.* exchange at 35*s.* 6*d.* flem. *per l* ſter?
Anſ. 254*l.* 18*s.* 1*d.* 1$\frac{61}{71}$*q.*

7. What quantity of flemiſh currency muſt I have for 290*l* 11*s.* 10*d.* ſter. exchange 33*s.* 10*d.* flem *per l* ſter. and agio at 4½ *per cent?* — *Anſ.* 513*l.* 14*s.* 1*d.* 1$\frac{917}{1000}$*q.*

8. How

8. How much sterling must I receive for 805*l.* 15*s.* flem. currency, the agio being 4 *per cent.* and exchange 34*s.* 6*d.* flem. *per l.* ster? — *Ans.* 449*l.* 2*s.* 8*d.* $2\frac{170}{199}q$.

9. To how much ster. will 7310 *marks*, 8 *sh.* 9 *ph.* amount, exchange at 36*s.* 4*d.* flem. *per l.* ster?

Ans. 536*l.* 11*s.* $3\frac{81}{109}q$.

10. How many marks must be received for 536*l.* ster. exchange at 36*s.* 4*d.* flem. *per l.* ster?—*Ans.* 7303 *marks.*

III. *With* FRANCE.

At France accounts are kept in livres, sols, and deniers; exchange being made by the french crown, whose *par* is 4*s.* 6*d.* sterling.

Note, 12 deniers——a sol or sou.
20 sols——a livre.
3 livres——a crown or ecu.

EXAMPLES.

1. How many livres, &c. will 275*l.* 12*s.* 8*d.* amount to, exchange at 50*d.* *per* ecu?—*Ans.* 3969 *li* 2 *sol.* $4\frac{4}{5}$ *d.*

2. To how much sterling will 900 crowns amount, exchange at 52*d.* *per* ecu? — — *Ans.* 195*l.*

3. How many french crowns may I have for 87*l.* 11*s.* 6*d* ster. exchange at $56\frac{1}{2}$*d.* *per* crown? — *Ans.* 372.

4. To how much ster. will 372 french crowns amount, exchange at $56\frac{1}{2}$*d.* each? —— *Ans.* 87*l.* 11*s.* 6*d.*

IV. *With* SPAIN, &c.

In Spain they keep their accounts in piastres, rials, and marvadies; reckoning 372 marvadies to a rial, and 8 rials to a piastre, by which they exchange, and whose *par* is 4*s.* 6*d.* sterling.

Note, In Genoa and Leghorn they keep their Accounts in livres, sols, and deniers, as in France, but exchange by the piastre as in Spain, which in Genoa is accounted 5 livres, and at Leghorn 6. At Venice, too, accounts are by some kept in the same manner, and by others in ducats and gross, reckoning 24 gross to a ducat, upon which they exchange, and whose par is accounted 4 s. 4 d. sterling.

EXAMPLES.

1. How many piastres, &c. shall I receive in Spain for 510*l.* ster. exchange 50*d.* ster. *per* piastre?

Ans. 2448 *piastres.*

 2. Spain

2. Spain draws upon London for 2448 piastres, exchange at 50*d.* *per* piastre; how much sterling will the draught amount to? —— —— *Ans.* 510*l.*

3. How many livres, *&c.* must be given at Genoa for 175*l.* 15*s.* ster. exchange at 52*d.* ster. *per* piastre?

Ans. 4055 *liv.* 15 *sol.* $4\frac{8}{13}$ *dens.*

4. Genoa draws upon London for 3000 livres: how much ster. will satisfy this draught, exchange at $50\frac{1}{2}$*d.* *per* piastre? —— —— *Ans.* 126*l.* 5*s.*

5. How many livres, *&c.* must be received at Leghorn for 705*l.* 16*s.* 4*d.* ster. exchange at $51\frac{1}{2}$*d.* ster. *per* piastre? — — *Ans.* 19735 *liv.* 9 *sol.* $1\frac{53}{103}$ *den.*

6. Leghorn draws upon London for 12000 *liv.* 14 *sol.* exchange at 50*d.* ster. *per* piastre: how much must be paid at London for this draught?

Ans. 416*l.* 13*s.* 9*d.* $3\frac{1}{15}$*q.*

7. How many ducats at Venice will a draught of 427*l.* ster. amount to, exchange at 49*d.* ster. *per* ducat?

Ans. 2091 *duc.* $10\frac{2}{7}$ *gro.*

8. Venice draws upon London for 2091 *duc.* 10 *gro.* exchange at 49*d.* ster. *per* ducat: to how much ster. does it amount? —— *Ans.* 426*l.* 19*s.* 11*d.* $1\frac{2}{3}$*q.*

V. *With* PORTUGAL.

In Portugal accounts are kept in milreas and reas, reckoning 1000 reas to a milrea, as its name imports; and they exchange by the milrea, whose *par* is about 6*s.* $8\frac{1}{2}$*d.* or 6*s.* 9*d.* sterling.

EXAMPLES.

1. To how many milreas will 715*l.* amount, exchange at 5*s.* 8*d.* *per* milrea? — *Ans.* 2523 *mil.* $529\frac{7}{17}$ *reas.*

2. To how many *l.* &c will a draught of 2523 *milr.* 529 *re.* amount, exchange at 5*s.* 8*d.* *per* milrea?

Ans. 714*l.* 19*s* 11*d.* $3\frac{111}{125}$*q.*

3. How many milreas must be given for 213*l.* 7*s.* 10*d.* exchange at 5*s.* $9\frac{1}{2}$*d.* *per* milrea?

Ans. 736 *milr.* $892\frac{12}{139}$ *reas.*

4. To how much sterling will 736 milreas amount, exchange at 5*s.* $9\frac{1}{2}$*d* *per* milrea? — *Ans.* 213*l.* 2*s.* 8*d.*

AL-

ALLIGATION.

ALLIGATION is the method of mixing together several simples of different qualities, so that the composition may be of a middle quality: and is commonly distinguished into two principal cases, denominated alligation medial and allegation alternate.

CASE I. ALLIGATION MEDIAL.

Alligation medial is the method of finding the rate of the compound, from having the rates and quantities of the several simples given.

Note, That by the rates are meant the numbers which determine, or define the proportions of the qualities of the simples and compound; such as the given prices of their integers, or numbers expressing their degrees of fineness, or any other numbers proportional to them. And if any one of the simples be of little or no value with respect to the rest, its rate is supposed to be 0; as water mixed with wine, or alloy with gold and silver.

RULE.

Multiply each quantity by its rate; then divide the sum of the products, by the sum of the quantities, or the whole composition; and the quotient will be the rate of the compound required.

EXAMPLES.

1. A composition being made of 5 *lb.* of tea, at 7*s.* *per lb.* 9 *lb.* at 8*s.* 6*d.* *per lb.* and $14\frac{1}{2}$ *lb.* at 5*s.* 10*d.* *per lb.* what is a *lb.* of it worth? — *Ans.* 6*s.* 10*d.* $2\frac{14}{57}$*q.*

2. What is a gallon of a composition of wine worth, which is made by mixing 4 gallons at 4*s.* 10*d.* *per* gallon, with 7 gallons at 5*s.* 3*d.* and $9\frac{3}{4}$ gallons at 5*s.* 8*d.* *per* gallon? —— —— *Ans.* 5*s.* 4*d.* $1\frac{45}{83}$ *q.*

3. Having mixed together 17 gallons of ale, at 9*d.* *per* gallon, 14 at $7\frac{1}{2}$*d.* 5 at $9\frac{1}{2}$*d.* and 21 at $4\frac{1}{2}$*d.* how much *per* gallon is the mixture worth? —— *Ans.* $7\frac{1}{57}$*d.*

4. A mixture being made of 12 bushels of oats, at 1*s.* 4*d.* *per* bush. 9 bushels of peas, at 1*s.* 7*d.* and 4 bush. 2 pecks of beans, at 1*s.* 2*d.* *per* bush. what will it be worth *per* bushel? — — *Ans.* 1*s.* 4*d.* $2\frac{14}{17}$*q.*

5. A compoſition being made by mixing 8 gallons of wine, worth 5*s.* 9*d. per* gall. with 7 gall. worth 5*s.* 11*d.* and 2 gall. of water: what is a gallon of it worth?

Anſ. 5*s.* 1*d.* $2\frac{14}{17}$*q.*

6. Having melted together 7 *oz.* of gold of 22 caracts fine, $12\frac{1}{2}$ *oz.* of 21 caracts fine, and 17 *oz.* of 19 caracts fine: I would know the fineneſs of the compoſition?

Anſ. $20\frac{19}{73}$ *caracts fine.*

7. Of what fineneſs is that compoſition, which is made by mixing 3 *lb.* of ſilver of 9 *oz.* fine, with 5 *lb.* 8 *oz.* of 10 *oz.* fine, and 1 *lb.* 10 *oz.* of alloy?—*Anſ.* $8\frac{58}{63}$ *oz. fine.*

CASE II. ALLIGATION ALTERNATE.

Alligation alternate is the method of finding what quantity of each of the ſimples whoſe rates are given, will compoſe a mixture of a given rate; ſo that it is the reverſe of alligation medial, and may therefore be proved by it.

RULE.

1. Write the rates of the ſimples in a column under each other.

2. Connect or link with a continued line, the rate of each ſimple which is leſs than that of the compound, with one or any number of thoſe which are greater than the compound, and each greater rate with one or any number of the leſs.

3. Write the difference between the mixture rate and that of each of the ſimples oppoſite the rates with which theſe are linked.

4. Then if only one difference ſtand againſt any rate, it will be the quantity belonging to that rate; but if there be ſeveral, their ſum will be the quantity.

Note, It appears from the rule that many of the queſtions of this caſe will admit of various anſwers each; but from an algebric proceſs it appears that they will all have infinite varieties of anſwers, nay, if the expreſſion may be allowed, that they will admit of infinite varieties of infinite varieties of anſwers. After one or more anſwers are found by the rule, as many more may be found as you pleaſe by increaſing or decreaſing the quantities in any proportion, or by only increaſing or decreaſing any one or more ſingle pairs of yoke fellows in any proportion, and leaving the other rates as they are: but as that anſwer is commonly deſired which gives

gives the rates in the least integer numbers, and those the nearest to each other, I have to each of the following questions put down such answers as I found by linking the rates together the most possible, and then, where no limitation was proposed, dividing the resulting quantities by their greatest common measure.

EXAMPLES.

1. How much wine at 6*s.* *per* gallon, and at 4*s.* *per* gallon, must be mixed together, that the composition may be worth 5*s.* *per* gallon?—*Ans.* 1 *qrt.* *or* 1 *gal.* *or any one equal quantity of each sort.*

2. How much sugar at 4*d.* at 6*d.* and at 11*d.* *per* pound, must be mixed together, that the composition may be worth 7*d.* *per* pound.—*Ans* 1 *lb.* *or* 1 *stone, or* 1 *cwt. or any other equal quantity of each sort.*

3. How much corn at 2*s.* 6*d.* at 3*s.* 8*d.* at 4*s.* and at 4*s.* 8*d.* *per* bushel, must be mixed together, that the compound may be worth 3*s.* 10*d.* *per* bushel?—*Ans.* 2 *at* 2*s.* 6*d.* 2 *at* 3*s.* 8*d.* 3 *at* 4*s.* *and* 3 *at* 4*s.* 8*d.*

4. A composition whose rate may be 7*s.* 6*d.* being to be made by mixing together five simples whose rates are 4*s.* 5*s.* 8*d.* 6*s.* 7*s.* 4*d.* and 8*s.* how much of each must be used? — *Ans. An equal quantity of the first four sorts, and* 14 *times the same quantity of the last sort.*

5. To mix gold of 19 caracts fine, with gold of 23, of 21, of 18, and of 17 caracts fine, that the compound may be 20 caracts fine: what quantity must be taken of each?

$$\textit{Ans.}\ 2\ \textit{at} \left\{\begin{matrix}17\\18\\19\end{matrix}\right. \quad \textit{and}\ 3\ \textit{at} \left\{\begin{matrix}21\\23\end{matrix}\right.$$

6. What are the proportions of the quantities of alloy, and gold of 22 caracts fine, which, when mixed together, will make the composition of 20 caracts fine?——*Ans. There must be* 10 *times as much gold as there is alloy.*

Note, Sometimes one or more of the ingredients, and sometimes the whole composition is limited to a certain quantity; which I divide into the three following cases, or limitations.

LIMITATION I.

When the whole composition is limited to a certain quantity, and that quantity is not found from the method of linking and taking the differences, then you may augment

augment or diminish the quantity of each ingredient in the same proportion as the given quantity is greater or less than the total quantity found from the linking, by saying, As the total quantity so found, is to the given quantity, so is the quanty of each ingredient, found by linking, to the required quantity of each.

EXAMPLES.

1. How much wine at 4*s.* at 5*s.* at 5*s.* 6*d.* and at 6*s.* a gallon, must be mixed together, to form a composition of 18 gallons, worth 5*s.* 4*d.* a gallon?

Ans. 3 *gal. at* $\begin{cases} 4s. \\ 5s. \end{cases}$ *and* 6 *gal. at* $\begin{cases} 5s.\ 6d. \\ 6s. \end{cases}$

2. How much gold of 15, of 17, of 18, and of 22 caracts fine, must be mixed together, to form a composition of 40 ounces, of 20 caracts fine?—*Ans.* 5 *oz. of* 15, *of* 17, *and of* 18, *and* 25 *oz. of* 22 *caracts fine.*

N. B. To this case belongs the question concerning king Hiero's crown, which the workman had debased with silver, or copper; and to find what quantity of gold and copper was in it, the famous Archimedes is said to have made two other crowns of the same weight with the former, the one of gold, and the other of silver, or copper; and by putting each into a vessel full of water, the quantity of water expelled by them determined their specific bulks: from which and their given weight it is easier to determine the quantities of gold and copper in the crown by this case of alligation, than by an algebraic process. I shall assume the same numbers which Ronayne has in his algebra, thus,

Suppose the weight of each crown to be 10 lb. and that the water expelled by the copper or silver was ·92 lb. by the gold ·52 lb. and by the compound crown was ·64 lb. that is, their specific bulks were as 92, 52, and 64.

Here then the rates of the simples are 92 and 52, and of the compound 64; whence

$64 \left| \begin{matrix} 92 \\ 52 \end{matrix} \right) \begin{matrix} 12 \text{ of copper.} \\ 28 \text{ of gold.} \end{matrix}$ $\Big\{$ The sum of these is $12 + 28 = 40$, which should have been but 10, wherefore by our rule

$40 : 10 :: \begin{cases} 12 : 3 \text{ lb. of copper.} \\ 28 : 7 \text{ lb. of gold.} \end{cases}$

LIMITATION II.

When one of the ingredients is limited to a certain quantity, and that quantitity is not found by the method of linking; you may either augment, or diminish, the quantities of all the rest in the same proportion as the given quantity

quantity is greater or less than the quantity of the limited simple found by linking, by stating as in the first limitation: * Or, you may only augment, or diminish, in the above proportion, that part of the quantities of the ingredients with which the limited one is linked, which is the difference of the mixture rate and the rate of the limited simple, and add the resulting quantity to the other parts, instead of the said difference; keeping the quantities of the other simples unaltered.

EXAMPLES.

1 How much wine at 5*s.* at 5*s.* 6*d.* and at 6*s.* the gallon, must be mixed with 3 gallons at 4*s.* the gallon, that the mixture may be worth 5*s.* 4*d.* a gallon?

Ans. { 3 *gal. at* 5*s.* / 6 - - - 5*s.* 6*d.* / 6 - - - 6*s.* } *by proportioning all the quantities:*

Or, { 10 *gal. at* 5*s.* / $8\frac{4}{5}$ - - - 5*s.* 6*d.* / $8\frac{4}{5}$ - - - 6*s* } *by proportioning only the difference of the mixture and limited rates.*

2. How much gold of 15, of 17, and of 22 caracts fine, must be mixed with 5 ounces of 18 caracts fine, that the composition may be of 20 caracts fine?

Ans. { 5 *oz. of* 15 *caracts fine* / 5 - - - 17 - - - - - / 25 - - - 22 - - - - - } *by proportioning all the quantities.*

Or, { 2 *oz. of* 15 *caracts fine* / 2 - - - 17 - - - - - / 13 - - - 22 - - - - - } *by proportioning only the difference of the mixture and limited rates.*

L I.

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* Hence we may observe that Mr. Malcolm has inadvertently given a rule in pag. 569 of his arithmetic, for questions of this sort when the limited simple is only once linked, which will not always give true answers; he says, " If the simple whose quantity is limited is only once linked, we need do no more than raise or diminish the quantity of that one simple with which it is link'd, and leave the rest as they are." Instead of which, if he had considered that the simple with which the limited one is linked, may also be linked with some one or more of the rest, I apprehend he would have said, Raise or diminish that part of the simple with which the limited one is linked, which is the difference between the mixture rate and the rate of the limited simple.

LIMITATION. III.

If more than one of the simples be limited, find by *case* I, what will be the rate of a mixture made of the given quantities of the limited simples only; then consider this as the rate of a limited simple; whose quantity is the sum of the first given limited simples, from which and the rates of the limited simples, by the second limitation, calculate the quantity of each.

EXAMPLES.

1. How much wine at 5*s.* 6*d.* and at 6*s.* a gallon, must be mixed with 3 gallons at 4*s.* and 3 gallons at 5*s.* a gallon, that the mixture may be worth 5*s.* 4*d.* a gallon?

Ans. 6 *gal. at* 5*s.* 6*d. and* 6 *gal. at* 6*s a gallon.*

2. How much gold of 15 and of 17 caracts fine, must be mixed with 5 ounces of 18, and 13 ounces of 22 caracts fine, that the composition may be of 20 caracts fine?

Ans. 2 *oz. of each sort.*

INVOLUTION.

A Power is a number produced by multiplying any given number continually into itself a certain number of times.

Any number is called the first power of itself; if it be multiplied by itself, the product is called the second power, and sometimes the square; if this be multiplied by the first power again, the product is called the third power, and sometimes the cube; and if this be multiplied by the first power again, the product is called the fourth power, *&c.* that is, the power is denominated from the number which exceeds the multiplications by 1.

Thus: 3 is the first power of 3.
$3 \times 3 = 9$ is the second power of 3.
$3 \times 3 \times 3 = 27$ is the third power of 3.
$3 \times 3 \times 3 \times 3 = 81$ is the fourth power of 3.
&c. &c.

And in this manner may be calculated the following

TA-

TABLE *of the first twelve Powers of the nine digits.*

1st power	1	2	3	4	5	6	7	8	9
2d power	1	4	9	16	25	36	49	64	81
3d power	1	8	27	64	125	216	343	512	729
4th power	1	16	81	256	625	1296	2041	4096	6561
5th power	1	32	243	1024	3125	7776	16807	32768	59049
6th power	1	64	729	4096	15625	46656	117649	262144	531441
7th power	1	128	2187	16384	78125	279936	823543	2097152	4782969
8th power	1	256	6561	65536	390625	1679616	5764801	16777216	43046721
9th power	1	512	19683	262144	1953125	10077696	40353607	134217728	387420489
10th power	1	1024	59049	1048576	9765625	60466176	282475249	1073741824	3486784401
11th power	1	2048	177147	4194304	48828125	362797056	1977326743	8589934592	31381059609
12th power	1	4096	531441	16777216	244140625	2176782336	13841287201	68719476736	282429536481

Note,

Note 1. The number which exceeds the multiplications by 1 is called the index, or exponent of the power: so the index of the first power is 1, that of the second power is 2, and that of the third is 3, &c.

2. Powers are commonly denoted by writing their indices above the first power: so the second power of 3 may be denoted thus 3^2, the third power thus 3^3, the fourth power thus 3^4, &c. and if the given number consist of several figures, a crooked line is sometimes drawn between them and the index: thus $\overline{503}|^6$, denotes the sixth power of 503.

Involution is the finding of powers; to do which, from their definition, there evidently comes this

RULE.

Multiply the given number, or first power, continually by itself, till the number of multiplications be 1 less than the index of the power to be found, and the last product will be the power required.

Note 1. Whence, because fractions are multiplied by taking the products of their numerators and of their denominators, they will be involved by raising each of their terms to the power required.——And if a mixt number be proposed, either reduce it to an improper fraction, or reduce the vulgar fraction to a decimal, and proceed by the rule.

2. The raising of powers will be a little shortened by working according to this observation; viz. whatever two or more powers are multiplied together, their product is the power whose index is the sum of the indices of the factors; or if a power be multiplied by itself, the product will be the power whose index is double of that which is multiplied: so, if I would find the sixth power; I might multiply the given number twice by itself for the third power, then the third power into itself would give the sixth power: or if I would find the seventh power; I might first find the third and fourth, and their product would be the seventh: or lastly, if I would find the eighth power; I might first find the second, then the second into itself would be the fourth, and this into itself would give the eighth.

EXAMPLES.

1. What is the second power of 45? — *Ans.* 2025.
2. What is the second power of 4·16?—*Ans.* 17·3056.
3. What is the second power of ·027?—*Ans.* ·000729.
4. What is the third power of 3·5? — *Ans.* 42·875.
5. What is the fourth power of 71·8?

Ans. 26576499·4576.

6. What is the fifth power of ·029?

Ans. ·0000000205111149.

7. What

7. What is the sixth power of 5·03?

Ans. 16196·005304479729.

8. What is the second power of $\frac{2}{3}$? — *Ans.* $\frac{4}{9}$.

9. What is the third power of $\frac{5}{9}$? — *Ans.* $\frac{125}{729}$.

10. What is the second power of $3\frac{2}{5}$?

Ans. $\frac{289}{25}$ or 11·56.

EVOLUTION.

THE root of any given number, or power, is such a number, as being multiplied into itself a certain number of times, will produce the power; and is denominated the first, second, third, fourth, *&c.* root, respectively as the number of multiplications made of it to produce the given power is 0, 1, 2, 3, *&c.* that is, the name of the root is taken from the number which exceeds the multiplications by 1, like the name of the power in involution.

Note 1. The index of the root, like that of the power in involution, is 1 more than the number of the multiplications necessary to produce the power or given number.

2. Roots are sometimes denoted by writing $\sqrt{}$ before the power, with the index of the root against it: so the third root of 50 is $\sqrt[3]{50}$, and the second root of it is $\sqrt{50}$, the index 2, being omitted; which index is always understood when a root is named or wrote without one. But if the power be expressed by several numbers with the sign +, or —, &c. between them, then a line is drawn from the top of the sign of the root, or radical sign, over all the parts of it: so the third root of 47—15 is $\sqrt[3]{47-15}$. And sometimes roots are designed like powers, with the reciprocal of the index of the root above the given number, and a line between them if the number have more than one figure in it. So the root of 3 is $3^{\frac{1}{2}}$, the root of 50 is $\overline{50}|^{\frac{1}{2}}$, and the third root of it is $\overline{50}|^{\frac{1}{3}}$; also the third root of 47—15 is $\overline{47-15}|^{\frac{1}{3}}$. And this method of notation has justly prevailed in the modern algebra; because such roots, being considered as fractional powers, need no other directions for any operations to be made with them than those for integral powers.

3. A number is called a complete power of any kind when its root of the same kind can be accurately extracted; but if not, the number is called an imperfect power, and its root a surd or irrational quantity: so 4 is a complete power of the second kind, its root being two; but an imperfect power of the third kind, its third root being a surd quantity.

Evolution is the finding of the roots of numbers, either accurately, or in decimals till the error be less than any proposed number.

The power is first to be prepared for extraction, or evolution, by dividing it, from the place of units, to the left in integers and to the right in decimal fractions, into periods containing each so many places of figures as are denominated by the index of the root, if the power contain a complete number of such periods: if it do not, the defect will be either on the right hand, or left, or both; if the defect be on the right hand, it may be supplied by annexing ciphers, and after this whole periods of ciphers may be annexed to continue the extraction with, if necessary; but if there be a defect on the left, such defective period must remain unaltered, and is accounted the first period of the given number, just the same as if it were complete.

Now this division may be conveniently made by writing a point over the place of units, and also over the last figure of every period on both sides of it; that is, over every second figure if it be the second root, over every third if it be the third root, &c. Thus, to point this number 21035896·12735 for the second root it will be 21035896·127350; but for the third root, thus 21035896·127350; and for the fourth, thus 21035896·12735000.

Note. The root will contain just so many places of figures as there are periods or points in the given power; and they will be integers, or decimals, respectively as the periods are so from which they are found, or to which they correspond; that is, there will be so many integer figures in the root, as there are periods of integers in the given number.

RULE *for extracting the square or second root of* integers, *or* decimals, *or* both mixed together.

1. Find, from the table of powers in page 107, or otherwise, a square number either equal to, or the next less than the first period; which subtract from it, and place the

the root of the ſquare on the right of the given number, after the manner of a quotient in diviſion, for the firſt figure of the root required.

2. To the remainder annex the ſecond period for a dividend; and on the left thereof write the double of the root already found, after the manner of a diviſor.

3. Conſider what figure, which, if annexed to the diviſor, and the reſult multiplied by it, the product may be equal to, or the next leſs than the dividend, and it will be the next figure of the root.

4. From the dividend ſubtract the product, and to the remainder bring down the next period, for a new dividend: to which, as before, find a diviſor by doubling the figures already found in the root; and from theſe find the next figure of the root, as in the laſt article; and continue the operation ſtill in the ſame manner till all the periods be uſed.

Note 1. In the laſt place of the following anſwers, I write ſuch figure as is neareſt the truth, whether it be too great or two little, i. e. if the next figure would equal or exceed 5, I increaſe the laſt place by 1, if not, I do not alter it: alſo when the root is too great, — is put after it, but when too little, +.

2. When the root is to be extracted to a great number of places, the work may be much abbreviated thus: having proceeded in the extraction after the common method till you have found one more than half the required number of figures in the root, the reſt may be found by dividing the laſt remainder by its correſponding diviſor, annexing a cipher to every dividual, as in diviſion of decimals; or rather, without annexing ciphers, by omitting continually the right hand figure of the diviſor, after the manner of the third contraction in diviſion of decimals in page 59. So the operation for the root of 2 to 12 or 13 places, may be thus.

2)1·41421356237 + *root.*

1

24	100
4	96
281	400
1	281
2824	11900
4	11296
28282	60400
2	56564
282841	383600
1	282841
2828423	10075900
3	8485269

2828426) 1590631 (56237 +

176418

6712

1055

206

8

EXAMPLES.

1. What is the root of 2025? —— *Ans.* 45.
2. What is the root of 17·3056? — *Ans.* 4·16.
3. What is the root of ·000729? — *Ans.* ·027.
4. What is the root of 3? — *Ans.* 1·73205 +.
5. What is the root of 5? — *Ans.* 2·236068 —.
6. What is the root of 6? — *Ans.* 2·44949 —.

7. What

7. What is the root of 7? — *Anſ.* 2·645751+.
8. What is the root of 10? — *Anſ.* 3·162278—.
9. What is the root of 11? — *Anſ.* 3·316625—.

RULES *for the ſquare roots of* vulgar fractions *and* mixt numbers.

Firſt prepare all vulgar fractions by reducing them to their leaſt terms, both for this and all other roots. Then

1. Take the root of the numerator and of the denominator for the reſpective terms of the root required. And this is the beſt way if the denominator be a complete power. But if it be not,

2. Multiply the numerator and denominator together; take the root of the product; this root being made the numerator to the denominator of the given fraction, or made the denominator to the numerator of it, will form the fractional root required.

That is, $\sqrt{\frac{a}{b}} = \frac{\sqrt{ab}}{b} = \frac{b}{\sqrt{ab}}$. And this rule will ſerve whether the root be finite or infinite. Or,

3. Reduce the vulgar fraction to a decimal, and extract its root.

4. Mixt numbers may be either reduced to improper fractions, and extracted by the firſt and ſecond rule; or, the vulgar fraction may be reduced to a decimal, then joined to the integer, and the root of the whole extracted.

EXAMPLES.

1. What is the root of $\frac{25}{36}$? — — *Anſ.* $\frac{5}{6}$.
2. What is the root of $\frac{27}{147}$? — — *Anſ.* $\frac{3}{7}$.
3. What is the root of $\frac{9}{12}$? — *Anſ.* ·866025+.
4. What is the root of $\frac{5}{12}$? — *Anſ.* ·645497+.
5. What is the root of $17\frac{3}{8}$? — *Anſ.* 4·168333+.

GENERAL RULE *for the extraction of all roots of* integers, *or* decimals.

1. Conſider what figure, to which if ciphers be annexed, it will be nearer the root of the given number than any other ſingle figure with ciphers: which figure will be the root of the next leſs power to the firſt period, of the ſame height with the given power, if the ſecond figure of the root be leſs than 5; but if it exceed or be only equal to 5,

 pro-

provided any more figures be to follow it, then the nearest figure will be the root of the next greater power than the first period. And in most cases it is very evident whether the second place of the root be less than 5 or not: for if the next less power be much nearer the first period than the next greater, the second figure is less than 5, and the contrary; but if the one power be almost as near to the first period as the other, the thing is not always so evident; for though the second place be always equal to or greater than 5 when the next greater power is any thing, though ever so little nearer to the first period than the next less power, yet it is not always less than 5 when the next less power is nearer than the next greater: so that when this is the case, annex 5 to the root of the next less power, and raise the result to the height of the given power, which will shew whether 5 be too great or too little.

2. Having found the nearest figure, involve it to the height of the given power; then take the difference between this power and the first period, and annex a cipher to it for a dividend.

3. And for a divisor, multiply the index of the root by such a power of the first found nearest figure whose index is less by 1 than that of the given power, or required root.

4. Their quotient will be the next figure of the root if the first figure be less than just; but if the first figure be greater than the root, annex a 0 to it, and subtract the quotient figure from the result, and consider the remainder as the two first figures of the root.

5. Involve the part of the root already found to the same height with the given power, and annex a 0 to the difference between this power and the first periods of the given number, for a dividend, as before. Then, as before also, find a divisor, by multiplying the index by such a power of the figures already found of the root whose index is less by 1 than that of the given power: let the two figures of the root, with a 0 annexed, be augmented or diminished by the quotient of these, according as they are too little or too great; and in making the addition or subduction, let the units place of the quotient correspond with, or be placed under, the cipher annexed to the former

mer

mer figures. Then, from the ſum or difference, find more figures of the root in the ſame manner: and ſo on as far as you pleaſe.

Note 1. Generally, the firſt diviſion may be continued to one place or figure, the ſecond to two, the third to four, and ſo on, always doubling the number of figures already found, by annexing a cipher continually to the remainders, or by omitting ſucceſſively the right-hand figures of the diviſor after the manner of the third contraction in diviſion of decimals: and by this method the ſucceſſive ſums or differences are commonly nearer to the true root than any other expreſſion of the ſame number of figures; ſo that when they are too little, the laſt figure increaſed by 1, makes them too great; and when they are in exceſs, the laſt figure diminiſhed by 1, makes them defective. Though very often the diviſion may be continued to many more figures of the root than theſe; and there is no danger in taking more figures; for if they happen to be wrong, the next diviſion will correct them. It is to be noted alſo, that the ſeveral diviſors and dividends are to be accounted integers.

2. The extraction of roots is greatly expedited by obſerving what integer numbers multiplied together produce the index of the required root and making ſuch extractions as are denominated by theſe numbers. Thus, inſtead of the fourth root, extract twice the ſquare root; inſtead of the ſixth, extract firſt the ſquare root, and then the cube root of that; inſtead of the eighth, extract thrice the ſquare root; and inſtead of the ninth, extract twice the cube root; and ſo on.

EXAMPLES.

1. To find the cube root of 21035896·12735?

	21035896·127350	30 —2
$3^3 =$	27	280 —39
$3^2 \times 3 =$ 27	..60(2	27610 —50464 &c.
$\overline{28}\vert^3 =$	21952	27604953 &c. —39188
$\overline{28}\vert^2 \times 3 =$ 2352	..9170 (39	276·0495260812
$\overline{2761}\vert^3 =$	21047437081	
$\overline{2761}\vert^2 \times 3 =$ 22869363	..115409540(50464 &c.	
$\overline{27604953}\vert^3 =$	21035897023228 &c.	
$\overline{27604953}\vert^2 \times 3 =$ 228610 &c.	.......895878 &c.(39188 &c.	

Note,

Note, It appears from this example, that we need find but a few of the first figures of the divisors and dividends, which greatly facilitates the work, for then the powers may be raised after the manner of the second contraction in multiplication of decimals.

2. To extract the fourth root of 21035896·12735.

```
  · ·  · ·  · ·   · ·    · ·  · ·
  21035896·12735(4586·49061(67·7236340 root.
  16                    36
  ----                  ----
 85 | 503            127 | 986
  5 | 425              7 | 889
 -----------         -----------
 908 | 7858          1347 | 9749
   8 | 7264             7 | 9429
 ------------        ------------
 9166 | 59496        13542 | 32006
    6 | 54996            2 | 27084
 ---------------     ----------------
 91724 | 450012      135443 | 492210
     4 | 366896           3 | 406329
 ---------------     ----------------
         83116(9061           85881(6340
         ---------            ---------
              564              4615
              ---              ----
               14               552
                                ---
                                 10
```

Note, Here I make two extractions of the square root, according to what was observed in note 2. page 115: for 2 × 2 = 4, 2 being the index of the square root, and 4 that of the root required.

3. To find the fifth root of 21035896·12735.

	21035896·12735	3
$3^5 =$	243	—08
$3^4 \times 5 = 405$	. 330 (08	292
		—53
$\overline{292}\rvert^5 =$	2122826 &c.	29·147
		—1029
$\overline{292}\rvert^4 \times 5 = 3634$ &c.	. . 19237 (53	
		29·1468971 the root.
$\overline{29{\cdot}147}\rvert^5 =$	21036267370 &c.	
$\overline{29{\cdot}147}\rvert^4 \times 5 = 360865$ &c.	. . . . . 371243 (10 29	

Note, In the firſt diviſion of this example, the firſt figure of the quotient being a cipher, it was neceſſary to continue it to another place, to make an alteration in the firſt figure of the root

4. What is the third root of 2? — *Anſ.* 1·259921+.
5. What is the fourth root of 2?— *Anſ.* 1·189207+.
6. What is the fifth root of 2? — *Anſ.* 1·148699—.
7. What is the ſixth root of 21035896·12735? *Anſ.* 16·61474—.
8. What is the ſixth root of 2?— *Anſ.* 1·122462—.
9. What is the ſeventh root of 21035896·12735? *Anſ.* 11·12083+.
10. What is the ſeventh root of 2? *Anſ.* 1·104089+.
11. What is the eighth root of 21035896·12735? *Anſ* 8·22943+.
12. What is the eighth root of 2?— *Anſ.* 1·090508—.
13. What is the ninth root of 21035896·12735? *Anſ.* 6·51122+.
14. What is the ninth root of 2?— *Anſ.* 1·080059+.

GENERAL RULES *for extracting any root out of a* vulgar fraction, *or* mixt number.

1. If the given fraction have a finite root of the kind required, it is beſt to extract the root out of the numerator and denominator, for the terms of the root required.

2. But

2. But if the fraction be not a complete power, it may be thrown into a decimal, and then extracted. Or,

3. Take either of the terms of the given fraction for the corresponding term of the root; and for the other term of the root, extract the required root of the product, arising from the multiplication of such a power of the first assigned term of the root whose index is less by 1 than that of the given power, by the other term of the given number. This rule will do when the root is either finite or infinite.

$$\text{That is } \overline{\frac{a}{b}}\Big|^{\frac{1}{n}} = \frac{\overline{ab^{n-1}}\big|^{\frac{1}{n}}}{b} = \frac{a}{\overline{ba^{n-1}}\big|^{\frac{1}{n}}}.$$

4. Mixt numbers may be reduced either to improper fractions or decimals, and then extracted.

EXAMPLES.

1. What is the cube root of $\frac{8}{27}$? —— *Ans.* $\frac{2}{3}$.
2. What is the fourth root of $\frac{80}{405}$? —— *Ans.* $\frac{2}{3}$.
3. What is the cube root of $\frac{1}{2}$? — *Ans.* ·7937005—.
4. What is the cube root of $2\frac{10}{27}$? — *Ans.* $\frac{4}{3}$ *or* $1\frac{1}{3}$.
5. What is the third root of $7\frac{1}{3}$? — *Ans.* 1·930979—.

Of PROPORTION *in* GENERAL.

NUMBERS are compared together to discover the relations they have to each other.

There must be two numbers to form a comparison: the number which is compared, being wrote first, is called the antecedent; and that to which it is compared, the consequent.

Numbers are compared to each other two different ways: the one comparison considers the difference of the two numbers, and is called arithmetical relation, the difference being sometimes named the arithmetical ratio; and the other considers their quotient, which is termed geometrical relation, and the quotient the geometrical ratio. So of these numbers 6 and 3; the difference, or arithmetical ratio, is $6-3=3$; and the geometrical ratio is $\frac{6}{3}=2$.

Note,

Note, Ratios are here always considered as the result of the greater term of comparison diminished, or divided, by the less; not regarding whether of them be the antecedent.

If two or more couplets of numbers have equal ratios, or differences, the equality is termed proportion; and their terms similarly posited, that is, either all the greater, or all the less taken as antecedents, and the rest as consequents, are called proportionals. So the two couplets 2, 4, and 6, 8, taken thus, 2, 4, 6, 8, or thus, 4, 2, 8, 6, are arithmetical proportionals; and the two couplets 2, 4, and 8, 16, taken thus, 2, 4, 8, 16, or thus, 4, 2, 16, 8, are geometrical proportionals.

To denote numbers as being geometrically proportional, the couplets are separated by a double colon, and a colon is wrote between the terms of each couplet: we may also denote arithmetical proportionals by separating the couplets with a double colon, and writing a colon, turned horizontally, between the terms of each couplet. So the above arithmeticals may be wrote thus, 2 . . 4 : : 6 . . 8, and 4 . . 2 : : 8 . . 6; where the first antecedent is less or greater than its consequent, by just so much as the second antecedent is less or greater than its consequent: and the geometricals thus, 2 : 4 : : 8 : 16, and 4 : 2 : : 16 : 8; where the first antecedent is contained in or contains its consequent, just so often as the second is contained in or contains its consequent.

Note, It is common to read the geometricals 4 : 2 : : 16 : 8, thus, 4 is to 2 as 16 to 8.

Proportion is distinguished into continual and discontinual.

If, of several couplets of proportionals, wrote down in a series, the difference or ratio of each consequent and the antecedent of the next following couplet be the same as the common difference or ratio of the couplets, the proportion is said to be continual, and the numbers themselves a series of continual proportionals, or an arithmetical or geometrical progression. So 2, 4, 6, 8 form an arithmetical progression; for $4-2=6-4=8-6=2$; and 2, 4, 8, 16 a geometrical progression; for $\frac{4}{2}=\frac{8}{4}=\frac{16}{8}=2$.

But

But if the difference or ratio of the consequent of one couplet and the antecedent of the next couplet, be not the same as the common difference or ratio of the couplets, the proportion is said to be discontinual. So 4, 2, 8, 6 are in discontinued arithmetrical proportion; for $4-2=8-6=2$, and $8-2=6$: also 4, 2, 16, 8 are in discontinued geometrical proportion; for $\frac{4}{2}=\frac{16}{8}=2$, and $\frac{16}{2}=8$.

If the succeeding terms of a progression exceed each other, it is called an ascending progression or series; if the contrary, a descending series.

So { 0, 1, 2, 3, 4, &c. is an ascending arithmetical series.
1, 2, 4, 8, 16, &c. is an ascending geometrical series.

and { 4, 3, 2, 1, 0, &c. is a descending arithmetical series.
16, 8, 4, 2, 1, &c. is a descending geometrical series.

Note, The first and last terms of a progression are called the extremes; and the other terms, the means.

ARITHMETICAL PROGRESSION.

AN arithmetical progression is a series whereof the succeeding terms are either all greater or less than their adjacent preceding terms by the same number or difference.

Note, the fundamental property of an arithmetical progression, from which almost all its other properties are deducible, and which evidently follows from its construction, is, that the sum of any two of its terms is equal to the sum of any other two terms taken at an equal distance, but on contrary sides of the former; or that the double of any one term is equal to the sum of any two terms taken at an equal distance from it on each side. And of any two couplets in discontinued arithmetical proportion, the two sums made by adding the antecedent of each to the consequent of the other are equal.

PROBLEM I.

From any given term, and with any given difference, to construct an arithmetical series.

RULE.

For an ascending series, add the difference to the first term, the sum will be the second; add the difference to the

the ſecond, the ſum will be the third; and ſo on, continually adding the difference to the term laſt found for the next ſucceeding term. And for a deſcending ſeries, ſubtract continually the common difference for the ſeveral ſucceeding terms.

EXAMPLE.

It is required to raiſe an arithmetical aſcending, and alſo a deſcending ſeries, with the common difference 3, and firſt term 24.

PROBLEM II.

From any given term of an arithmetical ſeries, whoſe common difference is known, to find any remote term, whoſe diſtance from the given term is known.

RULE.

To or from the given term, add or ſubtract the product of the common difference multiplied by the diſtance of the two terms; and the ſum or difference will be the term required, according as it is to be greater or leſs than the given term.

Note, By the diſtance of any two terms, is meant one leſs than the whole number of terms, ſuppoſed in the ſeries from the one term to the other incluſive — Though the chief uſe of this problem be when the firſt or leaſt term is given, to find the greateſt, it will ſerve equally well for any other two terms.

EXAMPLES.

1. What is the mth term of the aſcending or deſcending ſeries, whoſe common difference is d and firſt term a?

Anſ. $a \pm d \times \overline{m-1}$.

2. What is the 9th term of the aſcending ſeries, whoſe firſt term is 1 and common difference is 3? — *Anſ.* 25.

3. What is the 12th term of the aſcending ſeries, whoſe firſt term is 0 and common difference 2? — *Anſ.* 22.

4. What is the 7th term of the deſcending ſeries, whoſe firſt term is 60 and common difference 4? — *Anſ.* 36.

5. What is the 15th term of the deſcending ſeries, whoſe firſt term is 28 and common difference 2? — *Anſ.* 0.

6. If 7 be any term of a ſeries, whoſe common difference is 5; what is the term whoſe diſtance from it is expreſſed by 13, the required term being the greater? — *Anſ.* 72.

PROBLEM III.

Between any two given numbers to find any number of arithmetical means.

RULE.

Divide the difference of the two given numbers by one more than the number of means required, and the quotient will be the common difference; then from one of the given extremes and the common difference, find the required means by problem 1.

EXAMPLES.

To find m arithmetical means between a and z.

First $\frac{z \backsim a}{m+1}$ = the common difference; then the means are $a + \frac{z \backsim a}{m+1}$, $a + 2\frac{a \backsim a}{m+1}$, $a + 3\frac{z \backsim a}{m+1}$, &c. unto $a + m\frac{z \backsim a}{m+1}$.

2. To find an arithmetical mean between 2 and 6.

Anſ. 4.

3. To find two arithmetical means between 1 and 10.

Anſ. 4 *and* 7.

4 To find three arithmetical means between 0 and 24.

Anſ. 6, 12, *and* 18.

5. To find nine arithmetical means between 2 and 10.

Anſ. $2\frac{4}{5}$, $3\frac{3}{5}$, $4\frac{2}{5}$, $5\frac{1}{5}$, 6, $6\frac{4}{5}$, $7\frac{3}{5}$, $8\frac{2}{5}$ *and* $9\frac{1}{5}$.

PROBLEM IV.

Two terms, with their diſtance in the ſeries being given; to find any other term whoſe diſtance from either of the former is given.

RULE.

Divide the difference of the given terms by their diſtance, and the quotient will be the common difference of the ſeries; then find the terms required by prob. 2.

Note 1. When, in the following examples, the diſtance of the given terms is not expreſſed, they are ſuppoſed to be adjacent terms. Alſo when the place of the required term is given, but not the places of the given terms, they are ſuppoſed

poſed to be the two firſt terms of the ſeries. And, in both theſe caſes, the difference of the given terms is the common difference of the ſeries.

2. This problem is adapted for finding a mean proportional between, or a third proportional to any two given numbers, as well as for finding any other term.

EXAMPLES.

1. Given the diſtance n of the two terms a and z: it is required to find a term, whoſe diſtance from a is denoted by m.

Firſt $\frac{a \backsim z}{n}$ = the common difference; then $a \pm \frac{a \backsim z}{n} \times m$ = the term required.

Or, If the queſtion be propoſed in this manner: Given the mth term a, and the nth term z, of a ſeries; to find the pth term.

Then becauſe $m \backsim n$ is the diſtance between a and z, we ſhall have $\frac{a \backsim z}{m \backsim n}$ = the common difference; and ſince $m \backsim p$ is the diſtance between a and the required term, we ſhall have $a \pm \frac{a \backsim z}{m \backsim a} \times \overline{m \backsim p}$ = the term required.

2. What is the third term of the arithmetical ſeries, whoſe firſt and ſecond terms are 3 and 7? *Or*, To find a third arithmetic proportional to the numbers 3 and 7. *Anſ.* 11.

3. What is the ſecond term of the ſeries, whoſe firſt and third terms are 3 and 11? *Or*, To find a mean between the numbers 3 and 11. — — *Anſ.* 7.

4. What is the 20th term of the ſeries, whoſe two firſt terms are 0 and 5? — — — *Anſ.* 95.

5. What is the 34th term of the ſeries, whoſe fifth term is $5\frac{1}{5}$ and eleventh term is 10? —— *Anſ.* $28\frac{2}{5}$.

6. What is the eleventh term of the deſcending ſeries, whereof $9\frac{1}{5}$ and $5\frac{1}{5}$ are the ſecond and ſeventh terms? *Anſ.* 2.

7. Given the diſtance 12, of the two terms 5 and 19; to find a term whoſe diſtance from 5 ſhall be 40; the required term being greater than 5. —— *Anſ.* $51\frac{2}{3}$.

PROBLEM V.

Given one of the extremes, the common difference, and the number of terms of an arithmetical ſeries; to find

1. The other extreme.

RULE.

To or from the given term, according as it is the leaſt or greateſt, add or ſubtract the product of the common difference multiplied into 1 leſs than the number of terms, and the ſum or difference will be the term required.

2. The ſum of all the terms of the ſeries.

RULE.

Multiply the ſum of the extremes by the number of terms, and half the product will be the ſum of the ſeries.

Thus, if a repreſent the leſs extreme,
z the greater,
d the common difference,
n the number of terms, and
s the ſum of the ſeries;

$$\text{then} \begin{cases} z = a + d \times \overline{n-1}. \\ a = z - d \times \overline{n-1}. \end{cases} \text{and} \begin{cases} s = \dfrac{2a + dn - d}{2} \times n. \\ s = \dfrac{2z - dn + d}{2} \times n. \end{cases}$$

EXAMPLES.

1. Given the leaſt term 3, the common difference 2, and the number of terms 9: to find the greateſt term and the ſum of the ſeries?—*Anſ.* The greateſt term is 19, and the ſum of the ſeries is 99.

2. If the greateſt term be 70, the common difference 3, and the number of terms 21; what is the leaſt term, and the ſum of the ſeries?—*Anſ.* The leaſt term is 10, and the ſum is 840.

3. A debt can be diſcharged in a year, by paying 1 ſhilling the firſt week, 3 ſhillings the ſecond, and ſo on, always 2 ſhillings more every week: what is the debt, and what will the laſt payment be?—*Anſ.* The laſt payment will be 5*l.* 3*s.* and the debt is 135*l.* 4*s.*

PRO-

PROBLEM VI.

Given the extremes and the common difference, to find

1. The number of terms.

RULE.

Divide the difference of the extremes by the common difference, add 1 to the quotient, and the sum will be the number of terms.

2. The sum of the series.

Having found the number of terms, the sum of the series will be had by the 2d case of problem 5.

Thus, using the same symbols as before, $n = \frac{z-a}{d} + 1$.

and $s = \overline{a+z} \times \frac{z-a+d}{2d}$.

EXAMPLES.

1. If the extremes be 3 and 19, and the common difference 2; what is the number of terms, and the sum of the series? — *Ans.* The number of terms is 9, and the sum is 99.

2. If the extremes be 10 and 70, and the common difference 3; what is the number of terms, and the sum of the series? — *Ans.* The number of the terms is 21, and the sum is 840.

3. What debt can be discharged, and in what time, supposing the first week the payment be 1*s.* and the payments every week following to increase by 2*s.* till the last payment be 5*l.* 3*s*? — *Ans.* The debt is 135*l.* 4*s.* and will be discharged in a year or 52 weeks.

PROBLEM VII.

Given the extremes and the number of terms, to find

1. The common difference.

RULE.

This is found as in problem 4, by dividing the difference of the extremes by 1 less than the number of terms.

2. The ſum of the ſeries.

This is had from the 2d caſe of problem 5.

Thus, $d=\frac{z-a}{n-1}$, and $s=\frac{a+z}{2}\times n$.

EXAMPLES.

1. If the extremes be 3 and 19, and the number of terms 9; what is the common difference and ſum of the ſeries?—*Anſ.* The difference is 2, and the ſum is 99.

2. If the extremes be 10 and 70, and the number of terms 21; what is the common difference, and the ſum of the ſeries?—*Anſ.* The difference is 3, and the ſum is 840.

3. What debt can be diſcharged in a year, by weekly payments in arithmetical progreſſion, whereof the firſt term or payment is 1*s.* and the laſt is 5*l.* 3*s.* and what is the common difference of the ſeries of payments?

Anſ. The difference is 2*s.* and the debt is 135*l.* 4*s.*

PROBLEM VIII.

Given one of the extremes, the common difference, and the ſum of the ſeries; to find

1. The other extreme.

RULE.

To find the greateſt term; add twice the product of the common difference and ſum of the ſeries to the ſquare of the difference between the leaſt term and half the common difference; then the ſquare root of the ſum diminiſhed by half the common difference will be the greateſt term. To find the leaſt term; from the ſquare of the ſum of half the common difference and the greateſt term, ſubtract double the product of the common difference and ſum of the ſeries; then the ſquare root of the difference added to, or taken from, half the common difference, will give the leaſt term.

2. The number of terms.

Having now both the extremes and the common difference, the number of terms will be found by the firſt caſe of problem 6.

Thus

Thus $\begin{cases} z = \left(\overline{a \backsim \frac{1}{2}d}\,^{2} + 2ds\right)^{\frac{1}{2}} - \frac{1}{2}d. \\ a = \frac{1}{2}d \pm \left(\overline{z + \frac{1}{2}d}\,^{2} - 2ds\right)^{\frac{1}{2}} \end{cases}$

and $\begin{cases} n = \dfrac{\frac{1}{2}d - a + \left(\overline{a \backsim \frac{1}{2}d}\,^{2} + 2ds\right)^{\frac{1}{2}}}{d}. \\ n = \dfrac{\frac{1}{2}d + z \mp \left(\overline{z + \frac{1}{2}d}\,^{2} - 2ds\right)^{\frac{1}{2}}}{d}. \end{cases}$

EXAMPLES.

1 If the least term be 3, the common difference 2, and the sum of the series 99; what is the greatest term, and the number of the terms?—*Ans.* The greatest term is 19, and the number of terms 9.

2. If the greatest term be 70, the common difference 3, and the sum of the series 840; what is the least term, and the number of the terms?—*Ans.* The least term is 10, and the number of terms 21.

3. In what time will a debt of 135*l.* 4*s.* be discharged by weekly payments in arithmetical progression, the first term or payment being 1*s.* and the common difference 2*s.* and what will the last payment be?—*Ans.* The last payment will be 5*l.* 3*s.* and the debt will be discharged in a year.

PROBLEM IX.

Given one extreme, the sum of the series, and the number of terms; to find

1. The other extreme.

RULE.

Divide the sum of the series by the number of terms; then the double of the quotient diminished by the given extreme, is equal to the term required.

2. The common difference.

Having

Having now both the extremes and the number of terms, the common difference will be found by problem 4, or by the first case of problem 7.

Thus $z = \frac{2s}{n} - a$, or $a = \frac{2s}{n} - z$; and $\begin{cases} d = \frac{s - an}{n - 1} \times \frac{2}{n} \\ d = \frac{nz - s}{n - 1} \times \frac{2}{n} \end{cases}$

EXAMPLES.

1. If the least term be 3, the number of terms 9, and the sum of the series 99; what is the greatest term, and the common difference?—*Ans.* The greatest term is 19, and the common difference 2.

2. If the greatest term be 70, the number of terms 21, and the sum of the series 840; what is the least term, and the common difference?—*Ans.* The least term is 10, and the common difference 3.

3. A debt of 135*l.* 4*s.* can be discharged in a year, by weekly payments in arithmetical progression, the least term or payment being 1*s.* what will be the last or greatest payment, and the common difference of the payments? —*Ans.* The common difference will be 2*s.* and the last payment 5*l.* 3*s.*

PROBLEM X.

Given the two extremes and the sum of the series; to find

1. The number of terms.

RULE.

Divide double the sum of the series by the sum of the extremes, and the quotient will be the number of terms.

2. The common difference.

Having now the extremes and the number of terms, the common difference will be found as in problem 7.

Thus, $n = \frac{2s}{a + z}$, and $d = \frac{\overline{z + a} \times \overline{z - a}}{2s - a - z}$.

EXAMPLES.

1. If the extremes be 3 and 19, and the ſum of the ſeries 99; what is the number of terms, and the common difference? —*Anſ.* The number of terms is 9, and the common difference 2.

2. If the extremes be 10 and 70, and the ſum of the ſeries 840; what is the number of terms and the common difference?—*Anſ.* The number of terms is 21, and the common difference 3.

3. In what time will a debt of 135*l.* 4*s.* be diſcharged by weekly payments in arithmetical progreſſion, the firſt payment being 1*s.* and the laſt 5*l.* 3*s.* and what will be the common difference of the ſeries?—*Anſ.* The common difference will be 2*s.* and the debt will be diſcharged in a year.

PROBLEM XI.

Given the common difference, the number of terms, and the ſum of the ſeries; to find the extremes.

RULE.

Divide the ſum of the ſeries by the number of terms: then to and from the quotient, add and ſubtract half the product of the common difference into 1 leſs than the number of terms, and the ſum and difference will be the two extremes.

Thus, $a = \frac{s}{n} - \frac{n-1}{2}d$, and $z = \frac{s}{n} + \frac{n-1}{2}d$.

EXAMPLES.

1. If the common difference be 2, the number of terms 9, and the ſum of the ſeries 99; what are the extremes? *Anſ.* 3 and 19.

2. If the common difference be 3, the number of terms 21, and the ſum of the ſeries 840; what are the extremes? —— —— —— *Anſ.* 10 and 70.

3. If a debt of 135*l.* 4*s.* can be diſcharged in a year, by weekly payments in arithmetical progreſſion, whoſe common difference is 2*s.* what are the firſt and laſt payments? —— —— *Anſ.* 1*s.* and 5*l.* 3*s.*

GE-

GEOMETRICAL PROGRESSION.

A Geometrical progreſſion is a ſeries of numbers, whereof the ſucceeding terms are either all greater or leſs than their adjacent preceding terms, in ſuch ſort that the ratio or quotient of every two adjacent terms is the ſame.

Note, The ſame thing is true with reſpect to the products of the terms of a geometrical proportion as was obſerved of the ſums of the terms of an arithmetical proportion in the note in page 120. And the ſame analogy holds good in moſt of their problems: ſo that many of their rules are almoſt verbally the ſame, and differ only in this, that inſtead of the operations of addition, ſubtraction, multiplication, and diviſion in arithmetical progreſſion, are required reſpectively thoſe of multiplication, diviſion, involution, and evolution in geometrical progreſſion.

PROBLEM I.

From any given term, and with any given ratio, to conſtruct a geometrical ſeries.

RULE.

For an aſcending ſeries multiply the ratio into the firſt term, the product will be the ſecond; multiply the ratio into the ſecond, the product will be the third; and ſo on continually multiplying the ratio into the term laſt found for the next ſucceeding term. And for a deſcending ſeries, divide continually by the ratio, for the ſeveral ſucceeding terms.

EXAMPLE.

It is required to raiſe a geometrical aſcending, and alſo a deſcending ſeries, from the firſt term 24, with the ratio 3.

PROBLEM II.

From any given term of a geometrical ſeries, whoſe ratio is known, to find any other term, whoſe diſtance from the given term is known.

RULE.

Multiply or divide the given term, by ſuch power of the ratio, whoſe index is the given diſtance of the terms, and the product or quotient will be the required term, according as it is to be greater or leſs than the given term.

Note,

Note. When the power to which the ratio must be raised, is high, the operation will be abbreviated by working according to the 2d note in involution.—Though the chief use of this problem be when the least term is given to find the greatest, it is not confined to them; for it will serve equally well for any other two terms.—See the note to problem 2, in arithmetical progression, for what is meant by the distance of two terms.

EXAMPLES.

1. What is that term of a geometrical progression, whose distance from the term a is expressed by m, the ratio of the series being r?

Ans. ar^m or $\frac{a}{r^m}$.

2. What is the seventh term of the ascending series, whose first term is 1 and ratio 2? —— *Ans.* 64.

3. What is the 13th term of the descending series, whose first term is 60, and the ratio 3?—*Ans.* $\frac{20}{177147}$.

4. If 5 be any term of a series whose ratio is 4; what is the term whose distance from it is expressed by 5, the required term being the greater? —— *Ans.* 1280.

5. What is the 7th term of the ascending series whose 10th term is 10000 and ratio 3? —— *Ans.* $370\frac{10}{27}$.

PROBLEM III.

Between any two given numbers to find any number of geometrical means.

RULE.

Divide the greater number by the less, and extract such root of the quotient as is denominated by 1 more than the number of means required; which root will be the ratio; then from the ratio and one of the given numbers, the means may be found by problem 1.

EXAMPLES.

1. *To find m geometrical means between a and z.

First $\left.\frac{z}{a}\right|^{\frac{1}{m+1}}$ = the ratio; then the means are $a\times\left.\frac{z}{a}\right|^{\frac{1}{m+1}}$,

a

* It appears from the solution, that the required means are expressed by the $m+1$ root of the corresponding inter-

ter-

$$a \times \overline{\frac{z}{a}}\Big|^{\frac{2}{m+1}},\ a \times \overline{\frac{z}{a}}\Big|^{\frac{3}{m+1}},\ \text{\&c. unto } a \times \overline{\frac{z}{a}}\Big|^{\frac{m}{m+1}};\ \text{or, } \overline{a^m z}\big|^{\frac{1}{m+1}},$$

$$\overline{a^{m-1} z^2}\big|^{\frac{1}{m+1}},\ \overline{a^{m-2} z^3}\big|^{\frac{1}{m+1}},\ \text{\&c. unto } \overline{a z^m}\big|^{\frac{1}{m+1}}.$$

2. To find a mean between 2 and 8. — *Anſ.* 4.
3. To find a mean between 1 and 2—*Anſ.* 1·414213+.
4. To find two means between 1 and 27. *Anſ* 3 and 9.
5. To find three means between 8 and 128. *Anſ.* 16, 32, and 64.

PROBLEM IV.

Two terms, with their diſtance in the ſeries being given; to find any other term, whoſe diſtance from either of the given terms is known.

RULE.

---

termediate terms of the $\overline{m+1}$ power of the binomial $a+z$, but wanting their unciæ; and therefore if every term of the ſeries be raiſed to the $\overline{m+1}$ power, we ſhall have a^{m+1}, $a^m z$, $a^{m-1} z^2$, $a^{m-2} z^3$, $a^{m-3} z^4$, &c. unto $(a^{m-m} z^{m+1} =)\ z^{m+1}$, for the terms of the $\overline{m+1}$ power of $a+z$, without the unciæ. Whence algebraiſts may ſolve this problem without finding the ratio; for by involving $a+z$ to the $\overline{m+1}$ power, the $\overline{m+1}$ root of each of the intermediate terms, without their unciæ, will be the reſpective means.—Again, becauſe the ſimilar powers of proportionals are alſo proportional, the following method of compleating an imperfect ſquare naturally preſents itſelf, *viz.* Divide the ſecond term by the firſt, multiply the ſecond by the quotient, and $\frac{1}{4}$ of the product will be the third term: thus, if $x^2 + ax = b$; then $\frac{ax}{x^2} = \frac{a}{x}$, and $\frac{1}{4}ax \times \frac{a}{x} = \frac{1}{4}a^2 =$ the third term; and therefore $x^2 + ax + \frac{1}{4}a^2 = b + \frac{1}{4}a^2$; the left-hand ſide of which equation is a complete ſquare.

RULE.

Find the ratio, by extracting ſuch root of the quotient of the greater of the given terms divided by the leſs as is denominated by their diſtance; then the required term will be found by problem 2.

Note, The ſame obſervations are to be underſtood here as were made in the two notes to problem 4 of arithmetical progreſſion, only uſing the word quotient inſtead of difference, and ratio for common difference.

EXAMPLES.

1. Given the diſtance n of the two terms a and z, the latter being the greater; to find a term whoſe diſtance from a is denoted by m.

First $\overline{\frac{z}{a}}\Big|^{\frac{1}{n}}$ = the ratio; then $a \overset{\times}{\div} \overline{\frac{z}{a}}\Big|^{\frac{m}{n}}$ = the term required.

Or, If the queſtion be propoſed in this manner: Given the mth term a, and the nth term z, of a ſeries; to find the pth term.

Then $\overline{\frac{z}{a}}\Big|^{\frac{1}{n \backsim m}}$ = the ratio, and $a \overset{\times}{\div} \overline{\frac{z}{a}}\Big|^{\frac{p \backsim m}{n \backsim m}}$ = the term required.

2. What is the third term of the ſeries whoſe firſt and ſecond terms are 4 and 8? *Or*, To find a third proportional to the numbers 4 and 8. — — *Anſ.* 16.

3. What is the ſecond term of the ſeries whoſe firſt and third terms are 4 and 16? *Or*, To find a mean proportional between the numbers 4 and 16. — *Anſ.* 8.

4. What is the tenth term of the ſeries whoſe fifth term is 81, and eighth term 2187? — *Anſ.* 19683.

5. What is the ninth term of the ſeries whoſe third term is 1, and ſixth term $\frac{8}{27}$? —— *Anſ.* $\frac{64}{729}$.

6. Given the diſtance 6 of the two terms 7 and 14, to find a term whoſe diſtance from 14 ſhall be 4; the required term being the greateſt.—*Anſ.* $14 \times 2^{\frac{2}{3}} = 22{\cdot}2263+$.

PROBLEM V.

Given one of the extremes, the ratio, and the number of the terms of a geometrical ſeries; to find

1. The

1. The other extreme.

RULE.

Multiply or divide the given extreme by ſuch power of the ratio whoſe index is one leſs than the number of terms, and the product or quotient will be the required term, according as it is the greater or leſs extreme.

2. The ſum of the ſeries.

RULE.

Divide the difference of the extremes by the ratio leſs 1; to the quotient add the greater extreme, and it will give the ſum of the ſeries. *Or*, Multiply the greateſt term by the ratio, from the product ſubtract the leaſt term, then divide the difference by the ratio leſs 1, and the quotient will be the ſum of the ſeries.

Thus, if a repreſent the leaſt term,
z the greateſt,
r the ratio,
n the number of terms, and
s the ſum of the ſeries;

$$\text{then } \begin{cases} z = ar^{n-1}. \\ a = z \div r^{n-1}. \end{cases} \text{ and } \begin{cases} s = \dfrac{r^n - 1}{r - 1} \times a. \\ s = \dfrac{r^n - 1}{r - 1} \times \dfrac{z}{r^{n-1}}. \end{cases}$$

EXAMPLES.

1. Given the leaſt term 1, the ratio 2, and the number of terms 10; what is the greateſt term, and the ſum of the ſeries?—*Anſ.* The greateſt term is 512, and the ſum is 1023.

2. If the greateſt term be 885735, the ratio 3, and the number of terms 12; what is the leaſt term, and the ſum of the ſeries?—*Anſ.* The leaſt term is 5, and the ſum 1328600.

3. What debt will be diſcharged in a year or 12 months, by paying 1*l.* the firſt month, 2*l.* the ſecond, 4*l.* the third, and ſo on, each ſucceeding payment being double the laſt; and what will the laſt payment be?—*Anſ.* The debt is 4095*l.* and the laſt payment 2048*l.*

PRO-

PROBLEM VI.

Given the extremes, and the ratio, to find

1. The ſum of the ſeries.

This is found by the 2d caſe of the laſt problem.

2. The number of terms.

RULE.

Divide the greateſt term by the leaſt; find what power of the ratio is equal to the quotient; then add 1 to the index of that power, and the ſum will be the number of terms. *Or*, Divide the difference of the logarithms of the extremes by the logarithm of the ratio; add 1 to the quotient, and the ſum will be the number of terms.

Thus, $s=\frac{z-a}{r-1}+z=\frac{rz-a}{r-1}$, and $n=\frac{\log z-\log. a}{\log. r}$ $+1=\frac{\log. z-\log a+\log. r}{\log r.}$.

EXAMPLES.

1. If the extremes be 1 and 512, and the ratio 2; what is the ſum of the ſeries, and the number of terms?

Anſ. The ſum is 1023, and the number of terms 10.

2. If the extremes be 5 and 885735, and the ratio 3; what is the ſum of the ſeries, and the number of terms?

Anſ. The ſum is 1328600, and the number of terms 12.

3. What debt will be diſcharged by monthly payments in geometrical progreſſion, whereof the firſt is 1*l.* and the laſt 2048*l.* the ratio being 2; and in what time will it be diſcharged?—*Anſ.* The debt is 4095*l.* and will be diſcharged in a year.

PROBLEM VII.

Given the extremes and the number of terms, to find

1. The ratio.

This is found as in problem 4, by dividing the greater extreme by the leſs, and extracting ſuch root of the quotient whoſe index is equal to the number of terms minus 1.

2. The ſum of the ſeries.

 This

This is found as in problem 5.

$$\text{Thus, } r = \overline{\frac{z}{a}}\Big|^{\frac{1}{n-1}}, \text{ and } s = \frac{z \times \overline{\frac{z}{a}}\Big|^{\frac{1}{n-1}} - a}{\overline{\frac{z}{a}}\Big|^{\frac{1}{n-1}} - 1} = \frac{z^{\frac{n}{n-1}} - a^{\frac{n}{n-1}}}{z^{\frac{1}{n-1}} - a^{\frac{1}{n-1}}}.$$

EXAMPLES.

1. Given the extremes 1 and 512, and the number of terms 10; to find the ratio, and the ſum of the ſeries.

Anſ. The ratio is 2, and the ſum is 1023.

2. If the extremes of a ſeries, conſiſting of 12 terms, be 5 and 885735; what is the ratio, and the ſum of the ſeries?—*Anſ.* The ratio is 3, and the ſum is 1328600.

3. What debt can be diſcharged in a year by monthly payments in geometrical progreſſion, whereof the firſt payment is 1*l.* and the laſt 2048, and what will the ratio of the ſeries be?—*Anſ.* The ratio will be 2, and the debt 4095*l.*

PROBLEM VIII.

Given one of the extremes, the ſum of the ſeries, and the ratio; to find

1. The other extreme.

RULE.

To find the greateſt term, multiply the difference between the ſum of the ſeries and the given term by the ratio minus 1; divide the product by the ratio; to the quotient add the leaſt term, and the ſum will be the greateſt term.—To find the leaſt term, multiply the difference between the ſum of the ſeries and the given term by the ratio minus 1; ſubtract the product from the greateſt term, and the ſum will be the leaſt term.

2. The number of terms.

Having now both the extremes and the ratio, the number of terms will be found as in problem 6.

Thus

$$\text{Thus}\begin{cases} z = \dfrac{\overline{s-a}\times\overline{r-1}}{r} + a = \dfrac{sr - s + a}{r} \\ a = z - \overline{s-z}\times\overline{r-1} = zr - sr + s. \end{cases}$$

$$\text{and}\begin{cases} n = \dfrac{\log.\ z - \log.\ \overline{zr - sr + s}}{\log.\ r} + 1. \\ n = \dfrac{\log.\ \overline{sr - s + a} - \log.\ a}{\log.\ r}. \end{cases}$$

EXAMPLES.

1. Given the leaſt term 1, the ſum of the ſeries 1023, and the ratio 2; to find the greateſt term and the number of terms.—*Anſ.* The greateſt term is 512, and the number of terms 10.

2. If the greateſt term be 885735, the ſum of the ſeries 1328600, and the ratio 3; what is the leaſt term, and the number of terms? —*Anſ.* The leaſt term is 5, and the number of terms 12.

3. In what time will a debt of 4095*l.* be diſcharged by monthly payments in geometrical progreſſion, whereof the firſt term is 1*l.* and ratio 2; and what will the laſt payment be?—*Anſ.* The laſt payment will be 2048*l.* and the debt will be diſcharged in a year.

PROBLEM IX.

Given one extreme, the ſum of the ſeries, and the number of terms; to find the other extreme and the ratio.

Thus, the other extreme will be found from this equation, $z\times\overline{s-z}\,\rceil^{n-1} = a\times\overline{s-a}\,\rceil^{n-1}$, or $z^{\frac{n}{n-1}} - sz^{\frac{1}{n-1}} = a^{\frac{n}{n-1}} - sa^{\frac{1}{n-1}}$; and the ratio from one of theſe $r^n - \frac{s}{a}r = 1 - \frac{s}{a}$, or $r^n - \frac{s}{s-z}r^{n-1} = -\frac{z}{s-z}$, according as a or z is given.

Or, Having found one of thoſe, the other may be found by one of the former problems.

EXAMPLES.

1. Given the leaſt term 1, the ſum of the ſeries 1023, and the number of terms 10; to find the greateſt term, and the ratio.—*Anſ.* The greateſt term is 512, and the ratio 2.

2. What is the leaſt term and the ratio of a geometrical ſeries, whoſe greateſt term is 885735, the ſum of its terms 1328600, and the number of terms 12?

Anſ. The leaſt term is 5, and the ratio 3.

3. If a debt of 4095*l.* can be diſcharged in a year, by monthly payments in geometrical progreſſion, whoſe firſt term is 1*l.* what is the ratio of the ſeries, and what will the laſt payment be?—*Anſ.* The ratio is 2, and the laſt term 2048*l.*

PROBLEM X.

Given the extremes, and the ſum of the ſeries; to find

1. The ratio.

RULE.

Divide the difference between the ſum of the ſeries and the leaſt term by the difference between the ſum of the ſeries and the greateſt term, and the quotient will be the ratio.

2. The number of terms.

This is found by problem 6.

Thus, $r=\frac{s-a}{s-z}$, and $n=\frac{\log. z-\log. a}{\log. s-a-\log. s-z}+1.$

EXAMPLES.

1. Given the extremes 1 and 512, and the ſum of the ſeries 1023; to find the ratio, and the number of terms.

Anſ. The ratio is 2, and the number of terms 10.

2. If the extremes be 5 and 885735, and the ſum of the ſeries 1328600; what is the ratio, and the number of terms?—*Anſ.* The ratio is 3, and the number of terms 12.

3 In what time will a debt of 4095*l.* be diſcharged by monthly payments in geometrical progreſſion, the firſt payment being 1*l.* and the laſt 2048*l* and what is the ratio of the ſeries?—*Anſ.* The ratio is 2, and the debt will be diſcharged in a year.

PRO-

PROBLEM XI.

Given the ratio, the number of terms, and the ſum of the ſeries; to find the extremes.

RULE.

From the ratio ſubtract 1; raiſe the ratio to the power denominated by the number of terms, from which ſubtract 1; divide the firſt remainder by the laſt, then multiply the quotient into the ſum of the ſeries, and the product will be the leaſt term: from which, together with the ratio, and number of terms, the greateſt term will be found by problem 5.

Thus $a = \frac{r-1}{r^n-1} \times s$, and $z = \frac{r-1}{r^n-1} \times sr^{n-1}$.

EXAMPLES.

1. Given the ratio 2, the number of terms 10, and the ſum of the ſeries 1023; to find the extremes.

Anſ. The extremes are 1 and 512.

2. If the ratio of a ſeries be 3, the number of terms 12, and the ſum of the ſeries 1328600; what are the extremes? —— —— *Anſ.* 5 and 885735.

3. If a debt of 4095 *l.* can be diſcharged in a year, by monthly payments in geometrical progreſſion, the ratio being 2; what will the firſt and laſt payment be?

Anſ. 1*l* and 2048*l.*

SINGLE RULE *of* FALSE POSITION.

THIS rule is called falſe poſition (or falſe ſuppoſition) becauſe it makes a ſuppoſition of falſe numbers as if they were the true ones, and by their means diſcovers the true numbers ſought.

The ſingle rule uſes only one ſuppoſition, but the double rule two; whence come their names.

To the rule of poſition belong ſuch queſtions as cannot be ſolved by a direct proceſs by any of the former rules; and in which the required number or numbers do not aſcend above the firſt power: ſuch, for example, as moſt of the queſtions uſually brought to exerciſe the reduction of ſimple equations in analytics. But it will not

bring

bring out true anſwers when the numbers ſought aſcend above the firſt power; for then the reſults are not proportional with their poſitions, nor the errors with the difference of the true number and each poſition; yet in all ſuch caſes it is a very good approximation, and in exponential equations, as well as many other things, ſucceeds better than perhaps any other method.

Thoſe queſtions, in which the reſults are proportional to their ſuppoſitions, belong to ſingle poſition: ſuch are thoſe which require the multiplication or diviſion of the number ſought by any number, or where it is to be increaſed or diminiſhed by itſelf any number of times, or by any part or parts of it. And thoſe in which the reſults are not proportional to their poſitions, belong to the double rule: ſuch are thoſe, in which the number ſought is increaſed or diminiſhed by ſome given number, which is no known part of the number required.

To work queſtions in ſingle poſition.

Take any number, and perform the ſame operations with it as, in the queſtion, are deſcribed to be performed with the number ſought; then if the reſult be the ſame with that in the queſtion, the ſuppoſed number is the number ſought; but if it be not, ſay, As the reſult of your operation, is to your poſition, ſo is the reſult in the queſtion, to the number required.

Note. 1 may be made a conſtant ſuppoſition in all the queſtions, and in moſt caſes is better than any other.

EXAMPLES.

1. A perſon after ſpending $\frac{1}{3}$ and $\frac{1}{4}$ of his money, has yet remaining 60*l.* what had he at firſt?

1. Suppoſe he had at firſt 120*l.*

Then the $\frac{1}{3}$ of 120 is	40
$\frac{1}{4}$ of it is	30
their ſum is	70
which taken from	120
leaves	50

And $50 : 120 :: 60 : \frac{60 \times 120}{50} = \frac{60 \times 12}{5} = 12 \times 12 = 144.$

2.

2. Suppose he had 1*l.*

Then $\frac{1}{3}+\frac{1}{4}=\frac{4}{12}+\frac{3}{12}=\frac{7}{12}$, and $1-\frac{7}{12}=\frac{5}{12}$; whence $\frac{5}{12} : 1 :: 60 : 1\times60\times\frac{12}{5}=\frac{60\times12}{5}=12\times12=144$, as before.

Proof.

$\frac{1}{3}$ of 144 is	48
$\frac{1}{4}$ of it is	36
their sum is	84
which taken from	144
leaves	60 as *per* question.

2. What number is that, which multiplied by 7, and the product divided by 6, the quotient may be 14? *Ans.* 12.

3. What number is that, which being increased by $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ of itself, the sum shall be 125? — *Ans.* 60.

4. A general, after sending out a-foraging $\frac{1}{2}$ and $\frac{1}{3}$ of his men, had yet remaining 700; what number had he in command? —— —— *Ans.* 4200.

5. A gentleman distributed 78 pence among a number of poor people, consisting of men, women, and children; to each man he gave 6*d.* to each woman 4*d.* and to each child 2*d.* moreover there were twice so many women as men, and thrice so many children as women; how many were there of each?—*Ans.* 3 men, 6 women, and 18 children.

6 One being asked his age, said, if $\frac{3}{5}$ of the years I have lived, be multiplied by 7, and $\frac{2}{3}$ of them be added to the product, the sum will be 292: what was his age? *Ans.* 60 years.

DOUBLE RULE *of* FALSE POSITION.

HAVING taken any two convenient numbers, for the positions, proceed with each, according to the conditions of the question, as if it was the true number sought, and find how much the results are different from the result in the question; next multiply each of these errors or dif-

differences by the other's poſition; then if the errors be of the ſame affection, that is, if the reſults be both either too great or too little, divide the difference of the products by the difference of the errors, and the quotient will be the anſwer; but if the errors be of different affections, that is, if one reſult be too great and the other too little, divide the ſum of the products by the ſum of the errors, and the quotient will be the anſwer.

Or, Having found the errors, ſay, As the ſum, or difference of the errors, according as they are of a different, or the ſame kind, is to the difference of the ſuppoſitions; ſo is the leaſt error, to the correction of the ſuppoſition belonging to this error; which muſt be added to, or ſubtracted from it, according to the following conditions; *viz.* If the errors be of the ſame kind, add, or ſubtract the correction, to, or from this ſuppoſition, according as it is greater or leſs than the other ſuppoſition; but if the errors be of different kinds, add, or ſubtract, according as this ſuppoſition is the leſs or greater of the two; and the ſum, or difference, will be the number ſought.

Note, It is often of advantage to make 1 and 0 the two ſuppoſitions.

EXAMPLES.

1. What number is that, which being multiplied by 6, the product increaſed by 18, and the ſum divided by 9, the quotient will be 20?

Firſt, ſuppoſe 30 to be the number ſought; then $\frac{30\times6+18}{9}=10\times2+2=20+2=22$; but ought to have been 20; therefore the error is 2 in exceſs.

Again, ſuppoſe 18 to be the number ſought; then $\frac{18\times6+18}{9}=2\times6+2=12+2=14$; but ought to be 20; therefore the error is 6 in defect; alſo the errors are of different kinds or affections.

Whence, by the firſt rule, $\frac{30\times6+18\times2}{2+6=8}=\frac{15\times3+9\times1}{2}=\frac{54}{2}=27$, the number ſought.

And

And by the second rule, $2+6 : 30-18 :: 2 : \frac{2\times12}{8} = 3$, the correction; then $30-3=27$, the number sought.

But to work this by the note, suppose first 0; then $\frac{0\times6+18}{9} = \frac{18}{9} = 2$; but ought to be 20; therefore the error is 18 too little. Again, suppose 1; then $\frac{1\times6+18}{9} = \frac{2+6}{3} = \frac{8}{3} = 2\frac{2}{3}$; but should have been 20; therefore the error is $17\frac{1}{3}$ in defect also, and the errors are of the same kind.

Whence, by the first rule, $\frac{0\times17\frac{1}{3} \backsim 18\times1}{18-17\frac{1}{3}} = \frac{18}{\frac{2}{3}} = 9\times3 = 27$, the number sought.

And, by the second rule, $18-17\frac{1}{3} : 1-0 :: 17\frac{1}{3} : \frac{17\frac{1}{3}}{\frac{2}{3}} = \frac{52}{2} = 26$, the correction; then $1+26=27$, the number sought.

2. A son, asking his father how old he was, received the following answer: your age now is $\frac{1}{4}$ of mine; but 5 years ago, your age was only $\frac{1}{5}$ of mine, at that time: what were their ages? —— *Ans.* 80 and 20.

3. A workman was hired for 30 days, at 2*s.* 6*d.* *per* day, for every day he worked; but with this condition, that, for every day he played, he should forfeit 1*s.* Now it so happened, that, upon the whole, he had 2*l.* 14*s.* to receive. How many of the days did he work? *Ans.* 24.

4. A and B began to play together with equal sums of money: A first won 20 guineas, but afterwards lost back $\frac{2}{3}$ of what he then had; after which, A had 4 times as much as A. What sum did each begin with?

Ans. 100 guineas.

5. Two persons, A and B, have both the same income: A saves $\frac{1}{5}$ of his; but B, by spending 50*l.* *per annum* more than A, at the end of four years finds himself 100*l.* in debt. What doth each receive and spend *per annum?* —*Ans.* They receive 125*l.* *per ann.* also *A* spends 100*l.* and *B* spends 150*l.* *per annum.*

A

A PROMISCUOUS COLLECTION *of* QUESTIONS.

1. A was born when B was 21 years of age: How old will A be when B is 47; and what will be the Age of B when A is 60? —— *Anſ.* *A* 26, *B* 81.

2. What difference is there between twice five and twenty, and twice twenty-five? —— *Anſ.* 20.

3. What number taken from the ſquare of 48 will leave 16 times 54? —— —— *Anſ.* 1440.

4. What number added to the thirty-firſt part of 3813 will make the ſum 200? —— —— *Anſ.* 77.

5. What number deducted from the 23d part of 29440 will leave the 64th part of the ſame?—*Anſ.* 820.

6. The remainder of a diviſion is 325, the quotient 467, the diviſor is 43 more than the ſum of both; what is the dividend? —— —— *Anſ.* 390265.

7. A perſon, at the time of his out-ſetting in trade, owed 350*l.* and had in caſh 5307*l.* 10*s.* in wares 713*l.* 7*d.* and in good debts 210*l.* 5*s.* 10*d.* Now after having traded a year he owed 703*l.* 17*s.* and had in caſh 4874*l.* 9*s.* 4*d.* in bills 350*l.* in wares 1075*l.* 14*s.* $3\frac{1}{2}$*d.* and in recoverable debts 613*l.* 13*s.* $10\frac{1}{2}$*d.* What was his real gain that year? —— —— *Anſ.* 329*l.* 4*s.* 1*d.*

8. Two perſons depart from the ſame place at the ſame time, the one travels 30, the other 35 miles a day: How far are they diſtant after 7 days if they travel both the ſame road, and how far if they travel in contrary directions? —— —— *Anſ.* 35 and 455 miles.

9. A gentleman's daily expence is 4*l.* 8*s.* $1\frac{19}{365}$*d.* and he ſaves 500*l.* in the year: What is his yearly income? *Anſ.* 2107*l.* 12*s.*

10. Having a piece of land 11 poles in breadth, I demand what length of it muſt be taken to contain an acre, when 4 poles in breadth require 40 poles in length to contain the ſame? —— —— *Anſ.* 14*pls.* 3*yds.*

11. If a gentleman, whoſe annual income is 1000*l.* ſpend 21*l.* a week, whether will he ſave or run in debt, and how much in the year? —— *Anſ.* 92*l.* debt.

12. In

12. In the latitude of London, the diſtance round the earth, meaſuring directly eaſt or weſt, is about 15550 miles; now as the earth turns round in 23 hours 56 minutes, at what rate *per* hour is the city of London carried by this motion from weſt to eaſt?

Anſ $649\frac{259}{359}$ *miles an hour.*

13. In order to raiſe a joint ſtock of 10000*l.* A, B, and C, together ſubſcribe 7950*l.* and D the reſt: Now A and B are known together to have ſet their hands to 5800*l.* and A has been heard to ſay that he had undertaken for 550*l.* more than B. What did each proprietor advance?—*Anſ. A* 3175, *B* 2625, *C* 2150, *D* 2050.

14. A tradeſman increaſed his eſtate annually by 100*l.* more than $\frac{1}{4}$ part of it, and at the end of 4 years found that his eſtate amounted to 10342*l.* 3*s.* 9*d.* What had he at out-ſetting? — — *Anſ.* 4000*l.*

15. Paid 1012*l.* 10*s.* for 750*l.* taken in 7 years ago; at what rate *per cent. per ann.* did I pay intereſt? *Anſ* 5*l.*

16. What is the intereſt of 720*l* for 73 days, at 3*l.* *per cent. per annum?* —— *Anſ.* 4*l.* 6*s.* 4*d.* $3\frac{365}{1825}$*q.*

17. Part 1200 acres of land among A, B, and C, ſo that B may have 100 more than A, and C 64 more than B. —— —— *Anſ. A* 312, *B* 412, *C* 476.

18. Divide 1000 crowns, give A 120 more and B 96 leſs than C. —— *Anſ. A* 445, *B* 230, *C* 325.

19. To how much amounts the order, for which my factor, at the rate of $2\frac{1}{2}$ *per cent.* receives 22*l.* 10*s.*

Anſ. 900*l.*

20. What ſum of money will amount to 132*l.* 16*s.* 3*d.* in 15 months, at 5 *per cent. per annum* ſimple intereſt?

Anſ. 125*l.*

21. Laid out 165*l.* 15*s.* in wine at 4*s.* 3*d.* a gallon; ſome of which receiving damage in carriage, I ſold the reſt at 6*s.* 4*d.* a gallon, which produced only 110*l.* 16*s.* 8*d.* What quantity was damaged? — *Anſ.* 430 *gal.*

22. A father divided his fortune among his ſons, giving A 4 as often as B 3, and C 5 as often as B 6; what was the whole legacy, ſuppoſing A's ſhare were 5000*l?*

Anſ. 11875*l.*

23. A stationer sold quils at 10*s.* 6*d.* a thousand, by which he cleared $\frac{1}{3}$ of the money; but growing scarce, raised them to 12*s.* a thousand; what did he clear *per cent.* by the latter price? —— *Ans.* 71*l.* 8*s.* $6\frac{6}{7}$*d.*

24. If 1000 men, besieged in a town, with provisions for 5 weeks, allowing each man 16 *oz* a day, were reinforced with 500 men more; and hearing that they cannot be relieved till the end of 8 weeks; how many ounces a day must each man have, that the provision may last that time? —— —— *Ans.* $6\frac{2}{3}$ *oz.*

25. If a quantity of provisions serve 1500 men 12 weeks, at the rate of 20 ounces a day for each man; how many men will the same provisions maintain for 20 weeks, at the rate of 8 oz. a day for each man?—*Ans.* 2250 *men.*

26. In what time will the interest of 72*l.* 12*s.* equal that of 15*l.* 5*s.* for 64 days, at any rate of interest?

Ans. $13\frac{161}{363}$ *days.*

27. A person possessed of $\frac{3}{8}$ of a ship, sold $\frac{2}{3}$ of his share for 1260*l.* what was the reputed value of the whole at the same rate? —— —— *Ans.* 5040*l.*

28. What sum of money at $4\frac{1}{2}$ *per cent.* will clear 29*l.* 15*s.* in a year and a half's time? — *Ans.* 440*l.* 14*s.* $9\frac{7}{9}$*d.*

29. What number is that, to which if $\frac{2}{7}$ of $\frac{5}{9}$ be added, the sum will be 1? — — *Ans.* $\frac{53}{63}$.

30. A father dying, left his son a fortune, $\frac{1}{4}$ of which he ran through in 8 months; $\frac{3}{7}$ of the remainder lasted him a twelve-month longer, after which he had bare 410*l.* left: What did his father bequeath him?

Ans. 956*l* 13*s.* 4*d.*

31. Bought a quantity of goods for 250*l.* and 3 months after sold it for 275*l.* How much *per cent. per annum* did I gain by them? — — — *Ans.* 40*l.*

32. A guardian paid his ward 3500*l.* for 2500*l.* which he had had in his hands 8 years: What rate of interest did he allow him? — — *Ans.* 5 *per cent.*

33. Bought a quantity of goods for 150*l.* ready money, and sold it again for 200*l.* payable at the end of 9 months; what was the gain in ready money, supposing rebate to be made at 5 *per cent.* —*Ans.* 42*l.* 15*s.* $5\frac{1}{83}$*d.*

34. A

34. A person being asked the hour of the day, said, The time past noon is equal to $\frac{4}{5}$ths of the time till midnight: What was the time? — *Ans.* 20 *min. past* 5.

35. A person, looking on his watch, was asked what was the time of the day, who answered, It is between 4 and 5; but a more particular answer being required, he said that the hour and minute hands were then exactly together: What was the time? — *Ans.* 21$\frac{9}{11}$ *min. past* 4.

36 With 12 gallons of canary at 6*s.* 4*d* a gal. I mixed 18 gal. of white-wine at 4*s.* 10*d.* a gal. and 12 gal. of cyder at 3*s* 1*d* a gal. At what rate must I sell a quart of this composition so as to clear 10 *per cent?* *Ans.* 5*s.* 2$\frac{6}{7}$*d.*

37. Suppose that I have $\frac{3}{16}$ of a ship worth 1200*l.* what part of her have I left after selling $\frac{2}{5}$ of $\frac{4}{9}$ of my share, and what is it worth? — *Ans.* $\frac{37}{240}$ *worth* 185*l.*

38 What length must be cut off a board 8$\frac{1}{8}$ inches broad, to contain a square foot, or as much as 12 inches in length and 12 in breadth? — *Ans.* 17$\frac{13}{65}$ *inches.*

39. What sum of money will produce as much interest in 3$\frac{1}{5}$ years, as 210*l.* 3*s.* can produce in 5 years and 5 months? — — — *Ans.* 350*l.* 5*s.*

40. There is gained by trading with a ship 120*l.* 14*s.* Now suppose that $\frac{1}{4}$ of her belongs to S, $\frac{3}{8}$ to T, $\frac{1}{8}$ to V, and the rest to W; what must each have of the gain?— *Ans S* 30*l.* 3*s.* 6*d.* *T* 45*l.* 5*s.* 3*d.* *V* 15*l.* 1*s.* 9*d.* *W* 30*l.* 3*s.* 6*d.*

41. If 100*l.* in 5 years be allowed to gain 20*l.* 10*s.* in what time will any sum of money double itself at the same rate of interest? — — *Ans.* 24$\frac{16}{41}$ *years.*

42. What difference is there between the interest of 350*l.* at 4 *per cent.* for 8 years, and the discount of the same sum, at the same rate, and for the same time?

Ans. 27*l.* 3$\frac{1}{11}$*s.*

43. If, by selling goods at 50*s.* *per cwt.* I gain 20 *per cent.* what do I gain or lose *per cent.* by selling at 45*s.* *per cwt?* — — — — *Ans.* 8*l.* *gain.*

44. If, by remitting to Holland, at 34*s.* 6*d per l.* sterling, 4$\frac{1}{2}$ *per cent.* be gained; how goes the exchange, when by remittance I clear 10 *per cent?* *Ans.* 36*s.* 3$\frac{165}{209}$*d.*

O 2 45. Sold

45. Sold goods for 60 guineas, and by fo doing, loft 17 *per cent.* whereas I ought, in dealing, to have cleared 20 *per cent.* Then how much under their juft value were they fold? — — *Anf* 28*l.* 1*s* $8\frac{20}{83}$*d.*

46. If, by felling goods at 27*d. per lb.* I gain *cent. per cent.* what do I clear *per cent.* by felling for 9 guineas *per cwt?* — — — *Anf.* 50 *per cent.*

47. If 20 men can perform a piece of work in 12 days, how many will accomplifh another thrice as big in one-fifth of the time? — — — — *Anf.* 300.

48. A younger brother received 2430*l* which was juft $\frac{3}{10}$ of his elder brother's fortune; and 2 and $\frac{2}{3}$ times the elder's money was half as much again as the father was worth: What was that? — — *Anf.* 14400*l.*

49. A perfon making his will, gave to one child $\frac{13}{20}$ of his eftate, and the reft to another; and when thefe legacies came to be paid, the one turned out 600*l.* more than the other: What did the teftator die worth?

Anf. 2000*l.*

50. A father devifed $\frac{7}{18}$ of his eftate to one of his fons, and $\frac{7}{18}$ of the refidue to another, and the furplus to his relict for life: the children's legacies were found to be 257*l.* 3*s.* 4*d* different: Pray what money did he leave the widow the ufe of? —— *Anf.* 635*l.* $10\frac{38}{49}$*d.*

51. What number is that, from which, if you take $\frac{2}{7}$ of $\frac{3}{8}$, and to the remainder add $\frac{7}{16}$ of $\frac{1}{20}$, the fum will be 10? —— —— —— *Anf.* $10\frac{191}{2240}$.

52. There is a number which, if multiplied by $\frac{2}{3}$ of $\frac{7}{8}$ of $1\frac{1}{2}$, will produce 1: What is the fquare of that number?

Anf. $1\frac{15}{49}$.

53. A perfon dying, left his wife with child, and making his will, ordered that if fhe went with a fon, $\frac{2}{3}$ of his eftate fhould belong to him, and the remainder to his mother; and if fhe went with a daughter, he appointed the mother $\frac{2}{3}$ and the girl the remainder: but it happened that fhe was delivered both of a fon and daughter; by which fhe loft in equity 2400*l.* more than if it had been only a girl: what would have been her dowry had fhe had only a fon? —— —— *Anf.* 2100*l.*

54. Three

54. Three persons purchase together a ship, towards the payment of which A advanced $\frac{2}{9}$, and B $\frac{2}{7}$ of the value, and C 200*l.* How much paid A and B, and what part of the vessel had C?

Ans. A $90\frac{10}{31}$*l. B* $116\frac{4}{31}$*l. C* $\frac{31}{63}$ *part.*

55. A and B clear by an adventure at sea, 60 guineas, with which they agree to buy a horse and chaise, of which they were to have the use, in proportion to the sums adventured, which was found to be A 9 to B 8; they cleared 45 *per cent.* What money then did each send abroad?

Ans. A 74*l.* 2*s.* $4\frac{4}{17}$*d. and B* 65*l.* 17*s.* $7\frac{13}{17}$*d.*

56. In an article of trade, A gains 18*s.* 3*d.* and his adventure was 40*s.* more than B's, whose share of profit is but 12*s.* What are the particulars of their stock?

Ans. A 5*l.* 16*s.* $9\frac{3}{5}$*d. and B* 3*l.* 16*s.* $9\frac{3}{5}$*d.*

57. Three persons entered joint trade, to which A contributed 240*l.* and *B* 210*l.* they clear 120*l.* of which 30*l.* belongs of right to C. Required that person's stock, and the several gains of the other two?

Ans. C's stock 150*l. A gained* 48*l. and B* 42*l.*

58. A and B in partnership equally divide the gain; A's money, which was 96*l.* 12*s.* lay for 15 months, and B's for no more than 6: What was the adventure of the latter? — — — *Ans.* 241*l.* 10*s.*

59. Put out 420*l.* to interest, and in $6\frac{1}{2}$ years time there was found to be due 556*l.* 10*s.* What was the rate of interest? —— —— *Ans.* 5 *per cent.*

60. A clears 12*l.* in 6 months, B 15*l.* in 5 months, and C, whose stock was 40*l.* clears 21*l.* in 9 months: What was the whole stock? —— *Ans.* $125\frac{5}{7}$*l.*

61. A had 12 pipes of wine, which he parted with to B at $4\frac{1}{2}$ *per cent.* profit, who sold them to C for 40*l.* 12*s.* advantage; C made them over to D for 605*l.* 10*s.* and cleared thereby 6 *per cent.* How much a gallon did this wine cost A? — — *Ans.* 6*s.* $8\frac{6640}{11077}$*d.*

62. A, of Amsterdam, orders B of London, to remit to C of Paris, at $52\frac{1}{2}$*d.* ster. a crown, and to draw on P, of Antwerp, for the value, at $34\frac{1}{2}$*s* flem a *l.* ster. but as soon as B received the commission, the exchange was on

Paris at 53*d.* a crown: Pray at what rate of exchange ought B to draw on C, to execute his orders, and be no loſer? —— —— *Anſ.* 34*s.* $2\frac{5}{53}$*d.*

63. A, with intention to clear 20 guineas, on a bargain with B, rates hops at 15*d.* a *lb.* which coſt him $10\frac{1}{2}$*d.* B, apprized of that, ſets down malt, which coſt 20*s.* a quarter, at an adequate price: For how much malt did they contract? —— —— *Anſ.* 49 *qrs.*

64. A and B venturing equal ſums of money, clear by joint trade 180*l.* By agreement, A was to have 8 *per cent.* becauſe he ſpent time in the execution of the project, and B was to have only 5: What was allotted to A for his trouble? —— *Anſ.* 41*l.* 10*s.* $9\frac{3}{13}$*d.*

65. Laid out in a lot of muſlin 500*l.* upon examination of which, 3 parts in 9 proved damaged, ſo that I could make but 5*s.* a yard of the ſame; and by ſo doing find I loſt 50*l.* by it. At what rate per ell am I to part with the undamaged muſlin, in order to gain 50*l.* upon the whole? —— —— *Anſ.* 11*s.* $7\frac{2}{7}$*d.*

66. A, at Paris, draws on B, in London, 1400 crowns, at 56*d* ſter. a crown, for the value of which B draws again on A at 57*d.* ſterl. a crown, beſides reckoning commiſſion $\frac{1}{2}$ *per cent.* Did A gain or loſe by this tranſaction, and what? —— *Anſ. He gained* $17\frac{39}{57}$ *crowns.*

67. A, B, and C, are in company; A put in his ſhare of the ſtock for 6 months, and laid claim to $\frac{1}{6}$ of the profits; B put in his for 9 months; C advanced 500*l.* for 8 months, and required on the balance $\frac{3}{5}$ of the gain: Required the ſtock of the other two adventurers.

Anſ. A 185*l.* 3*s.* $8\frac{4}{9}$*d. and B* 172*l.* 16*s.* $9\frac{13}{17}$*d.*

68. A young hare ſtarts 40 yards before a greyhound, and is not perceived by him till ſhe has been up 40 ſeconds; ſhe ſcuds away at the rate of 10 miles an hour, and the dog, on view, makes after her at the rate of 18; how long will the courſe hold, and what ground will be run over, beginning with the out ſetting of the dog?

Anſ. $60\frac{5}{22}$ *ſec. and* 530 *yards run.*

69. If I leave Exeter at 8 o'clock on monday morning for London, and ride at the rate of 3 miles an hour without

out intermiſſion; and you ſet out from London for Exeter at 4 the ſame evening, and ride 4 miles an hour conſtantly: Suppoſing the diſtance between the two cities to be 130 miles, whereabout on the road ſhall you and I meet? —— *Anſ.* $69\frac{3}{7}$ *miles from Exeter.*

70. A reſervoir for water has two cocks to ſupply it; by the firſt alone it may may be filled in 40 minutes, by the ſecond in 50 min. and it hath a diſcharging cock, by which it may, when full, be emptied in 25 min. Now, ſuppoſing that theſe 3 cocks are all left open, and that the water comes in; in what time, ſuppoſing the influx and efflux of the water to be always alike, would this ciſtern be filled? —— —— *Anſ.* 3 *hrs.* 20 *min.*

71. A ſets out of London for Lincoln, at the very ſame time that B at Lincoln ſets forward for London, diſtant 100 miles: After 7 hours they meet on the road, and it then appeared that A had rode $1\frac{1}{2}$ miles an hour more than B. At what rate an hour did each of them travel?

Anſ. A $7\frac{25}{28}$, *and* B $6\frac{11}{28}$ *miles.*

72. A and B truck, A has $12\frac{1}{2}$ *cwt.* of Farnham hops, at 2*l.* 16*s.* a *cwt.* but in barter inſiſts on 3*l.* B has wine worth 5*s.* a gal. which he raiſes in proportion to A's demand. On the ballance A received but a *hhd.* of wine: What had he in ready money? — *Anſ.* 20*l.* 12*s.* 6*d.*

73. A, of Amſterdam, owes to B, of Paris, 3000 guilders of current ſpecie, which he is to remit to him, by order, the exchange 91*d* flem. *de banco* a crown, the agio 4 *per cent.* but when this was to be negotiated, the exchange was down at 90*d.* a crown, and the agio 5 *per cent.* What did B get by this turn of affairs.

Anſ. 5 *liv.* 12 *ſol.* $8\frac{584}{1183}$ *den.*

An

An APPENDIX,

Containing a Course of Book-keeping according to the method of Single Entry, with a Description of the Books, and Directions for using them: Very useful either for young Book-keepers entering into Business, or for Masters to teach in their Schools.

IT is very neceſſary that almoſt every perſon who is intended for buſineſs, ſhould learn a courſe of book-keeping of this kind, becauſe it is uſed in almoſt every ſhop. The italian method alone is not ſufficient; for it is a conſtant complaint among the merchants, &c. who uſe this method, that their boys, having learnt only the italian method, when they firſt come to buſineſs, are almoſt as ignorant in the management of their books as if they had never learnt any method. There are ſome boys who have not time to learn, or, perhaps, a capacity to underſtand a compleat courſe of the italian method; there are alſo many intended for ſuch kinds of buſineſs, as that the italian method would be thrown away upon them; to all ſuch, then, this method will be extremely uſeful. And even ſuppoſing a boy were intended for a buſineſs which requires the italian method alone, I would, notwithſtanding, have him taught this method firſt, if it were only to facilitate his acquiſition of the other. This method is ſo eaſy, that it may alſo be taught in a few weeks' time to young ladies as well as young gentlemen.

The forms of the books may be ſufficiently known by inſpection —In the day-book, every perſon is wrote down *Dr. to* the things he receives from you on truſt, and *Cr. by* thoſe which you receive from him. In the margin of the day-book are wrote the pages where the accounts ſtand in the ledger: Inſtead of theſe marginal figures, ſome make only a ſtroke with the pen, to ſhew that the account has been poſted, that is, entered in the ledger; but it is better to uſe the figures, for they ſhew, not only that the account has been poſted, but likewiſe where to find it in the ledger without looking in the alphabet. In the day-

book

book I have caſt up all the accounts, as I think it better to do ſo than to leave them uncalculated till the poſting; for, as a bill-of-parcels is generally ſent along with the goods, if you no not enter the amounts in the day-book, you will frequently have the mortification to find that your book-debts and bills-of-parcels will not agree; for calculations of the ſame accounts made at different times will ſometimes differ.

I have entered in the day-book what is received as well as what is delivered, which is abſolutely neceſſary in teaching; for the learner ought to make out all his own ledger from his day-book.

There are ſeveral other books kept by moſt merchants, as the caſh book, the book of houſe expences, the invoice book, &c.

Directions for the learner.

Having ruled your books in the proper form, copy into your day-book one month's accounts, then calculate them upon your ſlate or waſte-paper, to find if they be rightly caſt up, and to exerciſe you in calculations. Next rule your ſlate in the form of the ledger, and poſted upon it the accounts entered in the day-book, with their dates prefixed, obſerving to put on the Dr. ſide of each perſon's account, thoſe accounts to which he is Dr. in the day-book, and on the Cr. ſide thoſe by which he is Cr. and if any account conſiſt but of one article, you are to expreſs it particularly with its money in the columns; but if of ſeveral, write *to* or *by* ſundries, placing the ſum of the amounts of all the articles in the columns. After the accounts are, by correcting if neceſſary, placed according to the teacher's mind, tranſcribe them into your ledger, leaving a proper ſpace under each perſon's name to receive more accounts. Then under the proper letters in the alphabet enter thoſe names with the pages where they ſtand in the ledger; and laſtly, write the ledger pages to the ſeveral accounts in the day-book. Do the ſame with the next month's accounts, &c. till the whole be finiſhed. —But obſerve that you muſt not enter any perſon's name

down

down again which has been entered before till the ſpace, firſt aſſigned to it, ſhall be filled with articles; and then the account muſt be transferred to a new place, as Lady Strawberry's account is from fol. 1 to fol. 5.

When the firſt ledger, titled A, is filled with accounts, you muſt, as is done with the following ledger, transfer the unbalanced accounts to the ſecond ledger, titled B, &c. according to the order of the letters of the alphabet; and at the end of the old ledger draw out a balance account, placing your debts on one ſide, and your credits on the other.

DAY-BOOK.

	——January 1, 1766.——			£.	s.	d.
1	*Mr. James Elford, of Bath, Dr.*					
		s.	*d.*			
	To 15 yds. of fine broad cloth, at	13	6	10	2	6
	— 24 —— ſuperfine ——	18	9	22	10	-
				32	12	6
1	*Dr Triſtram Shandy, of York, Dr.*					
		s.	*d.*			
	To 12 gal. palm-ſack, at ——	8	6	5	2	-
	— 17 — port, red — ——	5	8	4	16	4
	— 9 — claret — ——	8	9	3	18	9
				13	17	1
	——4——					
1	*Mrs. Mary Maſterman, Dr.*					
		s.	*d.*			
	To 1½ *lb.* green tea, —— at	16	—	1	4	-
	— 2¼ congou, —— —	9	6	1	1	4½
	— ¼ ſtone of ſugar — —	5	—	-	1	3
	— A lump of ſugar, wt. 20½ *lb.* at —		8	-	13	8
				3	-	3½

Ja-

			£.	s.	d.
	January 9				
1	*Lady Strawberry, Dr.*	*s.* *d.*			
	To 9½ yds. of silk, — at	12 9	6	1	1½
	— 13 —— flowered ditto, —	15 6	10	1	6
			16	2	7½
	20				
1	*Sir Jonas Moore, Dr.*				
	To a ream of thick post paper		1	-	-
	27				
2	*Mr. James Wilson, Schoolmaster, Dr.*				
		s. *d.*			
	To 6 schoolmaster's guides, at	1 4½	-	8	3
	— 3 doz. copy books, ——	2 6	-	7	6
	— 2 quires foolscap, ——	- 10	-	1	8
	— 1 quire thin post, — —		-	1	-
			-	18	5
	Feb. 5				
2	*Mr. Alderman Ableman, Dr.*				
		l. *s.* *d.*			
	To a ledger ruled, ——		-	15	-
	— 5 C quils, —— at	- 2 6	-	12	6
	— 3 reams thick post, ——	1 - -	3	—	-
	— 6 quires pot —— —	- - 8	-	4	-
	— 40 reams blue demy ——	- 5 6	11	-	-
	— 2 penknives and an inkstand		-	6	-
			15	17	6
	12				
2	*William Winton, Esq; Dr.*				
		s. *d.*			
	To 20 *oz.* of nutmegs, — at	- 3	-	5	-
	— 5½ *lb.* coffee, — —	4 -	1	2	-
	— 3¼ — cocoa, — —	2 4	-	7	7
	— 4 — almonds — —	1 -	-	4	-
	— 8½ — raisins — —	- 7	-	4	11½
			2	3	6½

Feb. 20

		£	s.	d.
1	*Sir Jonas Moore, Cr.*			
	By Cash received of him in full	1	-	-

27

		oz.	dwt.	gr.		s.	d.	£	s.	d.
2	*Sir Jeffery Slingstone, Dr.*									
	To a silver punch-bowl	wt. 23	4	—	at	5	10	6	15	4
	— a tankard ——	10	3	6	--	6	2	3	2	8
	— a tea-pot and lamp	30	5	12	--	7	3	10	19	$5\frac{1}{4}$
	— 6 plates —	73	11	5	--	6	1	22	7	$5\frac{1}{4}$
	— 18 spoons —	41	—	10	--	6	3	12	16	$4\frac{1}{2}$
								56	1	4

March 10

			s.	d.	£	s.	d.
2	*Mr. William Watson, Dr.*						
	To 2 gal. rum ——	at	10	-	1	-	-
	— 4 — brandy ——	—	10	6	2	2	-
	— 3 — eng. gin —	—	5	-	-	15	-
					3	17	-

22

			s.	d.	£	s.	d.
1	*Doctor Tristram Shandy, of York, Dr.*						
	To $27\frac{3}{4}$ gal. sherry	at	6	2	8	11	$1\frac{1}{2}$
	— $22\frac{1}{2}$ — rhenish	—	6	4	7	2	6
	— 34 — lisbon	—	4	10	8	4	4
					23	17	$11\frac{1}{2}$

April 7

			s.	d.	£	s.	d.
3	*Sir Thomas Lawson, Dr.*						
	To $7\frac{1}{2}$ yds. of scarlet cloth	at	21	-	7	17	6
	— 4 superfine blue	—	20	-	4	-	-
	— $\frac{1}{4}$ velvet ——	—	18	-	-	4	6
	— 30 gold lace ——	—	10	6	15	15	-
					27	17	-

April

		s.	d.	£.	s.	d.
	——— April 12 ———					
1	*Lady Strawberry, Dr.*					
		s.	d.			
	To 11¾ yds. lustring at	6	10	4	-	3½
	— 14 — brocade —	11	3	7	17	6
				11	17	9½
	——— 24 ———					
3	*David Johnson, Esq; Dr.*					
		s.	d.			
	To 5 gal. lamp oil at	4	2	1	-	10
	— 3½ — train oil —	3	-	-	10	6
	— ¾ — sweet oil —	12	6	-	9	4½
				2	-	8½
	——— 25 ———					
1	*Mrs. Mary Masterman, Cr.*					
	By cash, received of her in full			3	-	3½
	——— May 3 ———					
1	*Mr James Elford, of Bath, Dr.*					
		s.	d.			
	To 27 yds. of yard-wide cloth at	8	4	11	5	-
	— 16 —— drugget ——	6	3	5	-	-
	— 12 —— serge ——	2	10	1	14	-
	— 32 —— shalloon ——	1	8	2	13	4
				20	12	4
	——— 10 ———					
3	*Sir Thomas Lawson, Dr.*					
		s.	d.			
	To 7 yds. superfine black cloth at	19	6	6	16	6
	— 12 — shalloon — —	2	4	1	8	-
	— 1 doz. and 9 coat buttons	2	6	-	4	4½
	— 2 —— 8 waistcoat ditto	1	3	-	3	4
				8	12	2½

			£.	s.	d.
	May 14				
3	*Mr. Nicholas Norton, of Durham, Dr.*	*s. d.*			
	To 9 pair worsted stockings at	4 6	2	-	6
	— 6 — silk ditto ——	15 9	4	14	6
	— 17 — thread ——	5 4	4	10	8
	— 23 — cotton ——	4 10	5	11	2
	— 14 — yarn ——	2 4	1	12	8
	— 18 — women's gloves ——	4 2	3	15	-
	— 19 yds of flannel ——	1 7½	1	10	10½
			23	15	4½
	20				
3	*David Johnson, Esq; Dr.*	*c. qr. lb. £. s. d.*			
	To 13 cheshire cheeses } wt.	5 3 12 at 1 12 6	9	10	4¼
	— 25 glocester ——	3 - 18 — 1 8 -	4	8	6
	— 47 stilton ——	1 2 5 — 2 4 8	3	8	11¼
			17	7	10
	26				
3	*Mrs. Shields, Dr.*	*d.*			
	To 8 *lb.* rice —— at	4½	-	3	-
	— 3½ — currants —— ——	5	-	1	5½
	— 2 quarts of vinegar ——	6	-	1	-
			-	5	5½
	June 3				
3	*Sir Thomas Lawson, Cr.*				
	By a bill on captain James Dixon		10	-	-
3	*Capt. James Dixon, Dr.*				
	qr. bush.	*£. s. d.*			
	To 7 3 of wheat at	1 8 -	10	6	6
	— 9 7 — rye ——	1 1 6	10	12	3¾
	— 17 4 — oats ——	- 10 8	9	6	8
			30	5	5¾

June

			£	s.	d.
	June 12				
2	*Sir Jeffery Slingstone, Cr.*				
	By a bank note received by the servant		20	-	-
	17				
1	*Mrs. Mary Masterman, Dr.*	s. d.			
	To 14 *lb.* hard soap at	- 6	-	7	-
	— 7 — soft — —	- 5	-	2	11
	— 3½ — starch —	- 5½	-	1	7½
	— 3½ — blue —	1 4	-	4	8
	— 40 — raisins —	- 4½	-	15	-
	— 3 doz. candles —	5 9	-	17	3
			2	8	5½
	21				
1	*Mrs. Masterman, Cr.*	s. d.			
	By 40 yds. russia sheeting at	2 2	4	6	8
	28				
3	*David Johnson, Esq; Dr.*	£. s. d.			
	To 17 *lb.* cream cheese at	- - 7½	-	10	7½
	— 53 ston 3 *lb* bacon —	- 4 8	12	8	4
	— 15½ firk. butter —	1 8 -	21	14	-
			34	12	11½
	July 3				
4	*Miss Fanny Dawson, of Liverpool, Dr.*	s. d.			
	To 14 yds. blue ribbon at	- 7½	-	8	9
	— 21 — white —	- 6	-	10	6
	— 12½ — lace —	3 6	2	3	9
	— 9 pair kid gloves —	2 4	1	1	-
			4	4	-
	7				
2	*Mr. James Wilson, Schoolmaster, Cr.*				
	By cash, received in full —		-	18	5

—— July 10 ——

		s.	d.	£.	s.	d.
4	*Mr. Roger Retail, of Newcastle upon Tyne, Dr.*					
	To $24\frac{1}{2}$ *lb.* royal green tea at	18	6	22	13	3
	— $21\frac{1}{4}$ — imperial ——	24	-	25	10	-
	— $35\frac{3}{4}$ — beſt bohea ——	13	10	24	14	$6\frac{1}{2}$
	— $17\frac{2}{3}$ — coffee — —	5	4	4	14	$2\frac{1}{2}$
	— 25 — double refin'd ſugar	1	$1\frac{1}{2}$	1	8	$1\frac{1}{2}$
	— 9 ſugar loaves, wt. 137 *lb.* at	-	$7\frac{1}{2}$	4	5	$7\frac{1}{2}$
				83	5	9

—— 17 ——

		s.	d.	£.	s.	d.
4	*Mr Charles Anderſon, Dr.*					
	To 6 mahogany chairs at	18	6	5	11	-
	— 2 elbow ditto ——	25	-	2	10	-
	— 2 pier glaſſes ——	36	-	3	12	-
				11	13	-

—— 24 ——

		s.	d.	£.	s.	d.
4	*Mr. Charles Anderſon, Dr.*					
	To 25 yds. curtain ſtuff at	2	2	2	14	2
	— 12 — ticking ——	1	3	-	15	-
	— 3 ſtone of feathers ——	25	-	3	15	-
	— 2 pier tables — ——	50	-	5	-	-
				12	4	2

—— 28 ——

		s.	d.	£.	s.	d.
3	*Capt. James Dixon, Dr.*					
	To 12 buſh. peas — at	2	9	1	13	-
	— 9 — beans — —	3	5	1	10	9
	— 17 — malt — —	4	8	3	19	4
	— 25 *lb.* hops — —	1	4	1	13	4
				8	16	5

Au-

		s.	d.	£	s.	d.
	August 1					
2	*William Winton, Esq; Dr.*					
	To 10 groſs of bottles at	22	-	11	-	-
	— 9 —— ſmall ditto —	15	-	6	15	-
	— 2 doz. wine glaſſes —	4	6	-	9	-
	— 3 decanters — —	1	2	-	3	6
				18	7	6
	7					
2	*Mr. Alderman Ableman, Cr.*					
	By a note upon Dr. James for			10	-	-
	— caſh, in full ——			5	17	6
				15	17	6
	12					
4	*Mr. Charles Anderſon Dr.*					
	To a Mahogany bed-ſtead			2	10	-
	2 ſtools — at	5	3	-	10	6
	poker, tongs, and fender			1	-	-
	2 other ſets of irons at	15	-	1	10	-
				5	10	6
	16					
3	*David Johnſon, Esq; Cr.*					
	By caſh, in part —— ——			50	-	-
	18					
5	*Mr. Conrade Compound, of Exeter, Dr.*					
	To $21\frac{3}{8}$ *lb.* cochineal at	29	6	31	10	$6\frac{3}{4}$
	$6\frac{1}{4}$ — opium ——	6	4	1	19	7
	$53\frac{1}{8}$ — ſcammony ——	8	10	23	9	$3\frac{1}{4}$
				56	19	5
	21					
4	*Mr. Charles Anderſon, Cr.*					
	By 5 pockets of hops, at 48 *s.*			12	-	-

					£.	s.	d.
	August 26						
4	*Mr. John Baker, Dr.*						
		s.	*d.*				
	To 5 grofs of brafs buttons at	18	-		4	10	-
	— 2 —— white ——	15	-		1	10	-
	— 7 doz. pair of buckles —	2	2	a pair	9	2	-
	— 12 trunk locks ——	-	10	each	-	10	-
	— 6 chamber ditto ——	2	6	—	-	15	-
					16	7	-
	Sept. 3						
5	*Mrs. March, Dr.*	*s.*	*d.*				
	To 8 farcenet hoods, at	4	3		1	14	-
	4						
1	*Lady Strawberry, Dr.*	*s.*	*d.*				
	To 12¼ yds. fattin at	10	8		6	10	8
	6						
2	*Mr. James Wilfon, Schoolmafter, Dr.*						
		s.	*d.*				
	To 6 fchoolmafter's guides at	1	4½		-	8	3
	— 1 thouf. pinions				-	2	6
	— 3 doz. copy-books ——	2	6		-	7	6
	— 3 quires of thin poft ——	1	-		-	3	-
	— Dr Lowth's eng. grammar				-	2	4
					1	3	7
	9						
3	*Mr. Nicholas Norton, Cr.*						
	By a bank note for —— ——				20	-	-
	12						
1	*Lady Strawberry, Dr.*	*s.*	*d.*				
	To 11⅜ yds. of velvet at	18	-		10	4	9
2	*Mr. James Wilfon, Schoolmafter, Dr.*						
	To the univerfal penman ——				1	5	-
	16						
5	*Mrs March, of Chefter, Dr.*						
	To 17 india fans at 3*s.* 10*d.*				3	5	2

Sept.

		£	s.	d.
	Sept. 18			
1	*Mrs. Mary Masterman, Dr.*			
	To cash, in full — —	1	18	$2\frac{3}{4}$
	22			
1	*Lady Strawberry, Cr.*			
	By cash, received by the Steward	20	-	-
	24			
4	*Mr. Charles Anderson, Cr.*			
	By cash, in full — —	17	7	8
	29			
5	*Mrs. March, Dr.* *s.* *d.*			
	To 21 yds. silver ribbon at 2 2	2	5	6
	$11\frac{1}{2}$ — fine lace — 10 6	6	-	9
		8	6	3
	Oct. 2			
5	*Mr. Samuel Edwards, Dr.*			
	To 14 *lb.* of flax at 1*s.* —	-	14	-
	4			
5	*Mr. R. Barber, Bristol, Stationer, Cr.*			
	By 30 reams of foolscap paper at 12*s.* 6*d.*	18	15	-
	6			
5	*Lady Strawberry, Dr.*			
	To $27\frac{1}{2}$ yds. of holland at 5*s.* 6*d.*	7	11	3
3	*David Johnson, Esq; Cr.*			
	By cash, in full — —	4	1	6
	10			
5	*Mr. Matthew Milton, of Norwich, Dr.*			
	s. *d.*			
	To 40 ells of dowlas at 1 6	3	-	-
	34 — diaper — 1 $4\frac{1}{2}$	2	6	9
	31 — holland — 5 8	8	15	8
		14	2	5
	13			
5	*Lady Strawberry, Dr.*			
	To 40 yds. of irish cloth at 3*s.* 4*d.*	6	13	4

		£.	s.	d.
	Oct. 15			
6	*Mr. Henry Forster, Dr.*			
	To $2\frac{1}{2}$ cwt. of iron at 18*s*. 9*d*. ——	2	6	$10\frac{1}{2}$
	21			
6	*Mrs. Mary Gray, Cr.*			
	By 3 ps. irish cloth, quant. 87 yds. at 2*s*. 2*d*.	9	8	6
	23			
4	*Mr. John Baker, Cr.*			
	By cash, in part —— ——	10	-	-
	——			
5	*Mrs. March, Dr.*			
	s. d.			
	To 9 pair of kid gloves at 2 2	-	19	6
	— 5 doz. pair lamb's ditto — 1 2	3	10	-
	— 12 pieces of bobbin — - 6	-	6	-
		4	15	6
	25			
5	*Lady Strawberry, Cr.*			
	By cash, in full —— ——	39	-	5
	27			
5	*Mr. Samuel Edwards, Dr.*			
	d.			
	To 12 *lb*. of flax — at 10	-	10	-
	— 14 —— — — 9	-	10	6
		1	-	6
	30			
5	*Mr. Matthew Milton, Cr.*			
	By 30 gal. brandy at 8*s*. 6*d*. —	12	15	-
	— cash, in full —— ——	1	7	5
		14	2	5
	Nov. 4			
1	*Doctor Tristram Shandy, Cr.*			
	By cash, in full —— ——	37	15	$-\frac{1}{2}$
	7			
6	*Samuel Simpson, Esq; Dr.*			
	To 3 sugar loaves, wt. $32\frac{1}{4}$ *lb*. at $8\frac{1}{2}$*d*.	1	3	$-\frac{1}{4}$

Nov.

		s.	d.	£.	s.	d.
	Nov. 13					
1	*Mr. James Elford, Cr.*					
	By a bill for — —			50	-	-
	15					
3	*Capt. James Dixon, Cr.*					
	By 3 pieces of holland, qt. $112\frac{1}{2}$ ells, at *7s. 6d.* — — —			42	3	9
	15					
3	*Capt. James Dixon, Dr.*					
	To cash, in full — —			3	1	$10\frac{1}{2}$
	20					
6	*Samuel Simpson, Esq; Dr.*					
	To $15\frac{1}{2}$ *lb.* of currants, at 4*d.* —			-	5	2
	22					
6	*Mr. Thomas Grey, Dr.*					
		s.	d.			
	To 2 doz. knives and forks at	15	-	1	10	-
	— a set of china —			2	10	-
	— 18 china plates — —	2	3	2	-	6
	— 3 dishes — —	4	6	-	13	6
	— a mahogany tea board —			-	10	6
				7	4	6
	26					
6	*Mr. Thomas Grey, Cr.*					
	By 42 ells of holland at 5*s.* 6*d.*			11	11	-
	28					
2	*Sir Jeffery Slingstone, Cr.*					
	By cash, in full — —			36	1	4
	29					
6	*Samuel Simpson, Esq; Dr.*					
		s.	d.			
	To $17\frac{1}{4}$ *lb.* malaga raisins at	-	$5\frac{1}{2}$	-	7	$10\frac{3}{4}$
	— $19\frac{3}{4}$ — raisins of the sun —	-	6	-	9	$10\frac{1}{2}$
	— 17 — rice — —	-	$3\frac{1}{2}$	-	4	$11\frac{1}{2}$
	— $8\frac{1}{4}$ — pepper — —	1	6	-	12	$4\frac{1}{2}$
	— 13 *oz.* cloves — —	-	9	-	9	9
				2	4	$10\frac{1}{4}$

Dec.

		£.	s.	d.
	Dec. 1.			
2	*Mr. James Wilſon, Schoolmaſter, Cr.*			
	By caſh, in full	2	8	7
	3			
2	*Mr. Alderman Ableman, Dr.*			
	To a pipe of wine	25	-	-
	6			
2	*William Winton, Eſq; Cr.*			
	By 30 gal. brandy, at 7*s*. 6*d*.	11	5	-
	— caſh, in full	9	6	$0\frac{1}{2}$
		20	11	$0\frac{1}{2}$
	8			
6	*Mr. Thomas Hunter, Dr.*			
	To 3 chaldrons of coals at 1*l*. 15*s*.	5	5	-
	10			
2	*Mr. William Watſon, Cr.*			
	By caſh, in full	3	17	-
	12			
7	*Peter Thompſon, of Worceſter, Eſq; Dr.*			
	To 5 buts of oil, wt. 55 *cwt*. 1 *qr*. 20 *lb*. groſs, tare 18 *lb*. a *cwt*. at 24*l*. 10*s*. a tun of 236 gal. and $7\frac{1}{2}$ *lb*. neat to the gallon	72	2	$5\frac{1}{4}$
	13			
6	*Mr Henry Forſter, Cr.*			
	By caſh, in full	2	6	$10\frac{1}{2}$
	15			
3	*Sir Thomas Lawſon, Cr.*			
	By 3 *c*. 2 *qr*. 14 *lb*. of tobacco at 4*l*. a *cwt*.	14	10	-

		£.	s.	d.
	Dec. 18			
3	*Mrs. Shields, Dr.*			
	To a lump of ſugar wt. 22$\frac{3}{4}$ *lb.* at 8$\frac{1}{2}$*d.*	-	16	1$\frac{1}{4}$
	20			
6	*Samuel Simpſon, Eſq; Cr.*			
	By caſh, in full — —	3	13	0$\frac{1}{2}$
	22			
4	*Miſs Fanny Dawſon, Cr.*			
	By caſh, in full — —	4	4	..
	23			
7	*Mr. Edward Young, Dr.*			
	To 3 cwt. 1 qr. cheeſe at 30 *s.* —	4	17	6
	24			
4	*Mr. Roger Retail, Cr.*			
	By a bill upon Thomas Williams, Eſq; for	50	-	-
3	*Mrs. Shields, Cr.*			
	By caſh, in full — — —	1	1	6$\frac{3}{4}$
	29			
5	*Mrs. March, Cr.*			
	By caſh, in full — — —	18	-	11
	30			
7	*Mr. Joſeph King, of Windſor, Cr.*			
	By 18 qr. 4 buſh of wheat at 1*l.* 8*s.*	25	18	-

LEDGER A.

The ALPHABET.

A		**B**		**C**	
Alder. Ableman	2	*Mr. J. Baker*	4	*Mr. C. Compound*	4
Mr. C. Anderson	4	*Mr. R. Barber*	5		
		Balance	7		
D		**E**		**F**	
Capt. J. Dixon	3	*Mr. J. Elford*	1	*Mr. H. Forster*	6
Miss F. Dawson	4	*Mr. S. Edwards*	5		
G		**H**		**I**	
Mrs. M. Gray	6	*Mr. T. Hunter*	6	*D. Johnson, Esq;*	3
Mr. T. Grey	6				
K		**L**		**M**	
Mr. J. King	7	*Sir T. Lawson*	3	*Sir J. Moore*	1
				M. Masterman	1
				Mrs. March	5
				Mr. M. Milton	5
N		**O**		**P**	
Mr. N. Norton	3				
Q		**R**		**S**	
		Mr. R. Retail	4	*D. T. Shandy*	1
				L. Strawberry	1, 5
				Sir J. Slingstone	2
				Mrs. Shields	3
				S. Simpson, Esq;	6
T		**V**		**W**	
P. Thompson, Esq;	7			*Mr. J. Wilson*	2
				W. Winton, Esq;	2
				Mr. W. Watson	2
X		**Y**		**Z**	
		Mr. E. Young	7		

		£.	s.	d.
1766	*Dr.* *Mr. James*			
Jan. 1	To sundries ——	32	12	6
May 3	To sundries ——	20	12	4
		53	4	10

		£.	s.	d.
1766	*Dr.* *Doctor Tristram*			
Jan. 1	To sundries — —	13	17	1
Mar. 22	To sundries — —	23	17	11½
		37	15	0½

		£.	s.	d.
1766	*Dr.* *Mrs. Mary*			
Jan. 4	To sundries ——	3	-	3½
June 17	To sundries ——	2	8	5¼
Sept. 18	To cash, in full ——	1	18	2¼
		7	6	11½

		£.	s.	d.
1766	*Dr.* *Lady Strawberry*			
Jan. 9	To sundries ——	16	2	7½
Apr. 12	To sundries ——	11	17	9½
Sept 4	To 12¼ yds sattin, at 10*s.* 8*d.*	6	10	8
12	To 11⅜ yds. velvet, at 18*s.*	10	4	9
		44	15	10

		£.	s.	d.
1766	*Dr.* *Sir Jonas*			
Jan. 20	To a ream of paper —	1	-	-

1766	*Elford, of Bath, Cr.*	£.	s.	d.
Nov. 12	By a bill for ———	50	-	-
	By account at fol. 1, ledger B	3	4	10
		53	4	10

	Shandy, of York, Cr.			
1766				
Nov. 4	By cash, in full ———	37	15	$0\frac{1}{2}$

	Masterman, Cr.			
1766				
Apr. 25	By cash, in full ———	3	-	$3\frac{1}{2}$
June 21	By 40 yds of sheeting, at 2*s*. 2*d*	4	6	8
		7	6	$11\frac{1}{2}$

	Cr.			
1766				
Sept. 22	By cash, received by the steward	20	-	-
	By account at fol. 5 —	24	15	10
		44	15	10

1766	*Moore, Cr.*			
Feb. 20	By cash, in full ———	1	-	-

1766	Dr. Mr. James	£.	s.	d.
Jan. 27	To ſundries ——	-	18	5
Sept. 6	To ſundries ——	1	3	7
12	To the univerſal penman	1	5	-
		3	7	0

1766	Dr. Mr. Alderman			
Feb. 5	To ſundries ——	15	17	-
Dec. 3	To a pipe of wine —	25	-	-

1766	Dr. William			
Feb. 12	To ſundries ——	2	3	6½
Aug. 1.	To ſundries ——	18	7	6
		20	11	0½

1766	Dr. Sir Jeffery			
Feb. 27	To ſundries ——	56	1	4

1766	Dr. Mr. William			
Mar. 10	To ſundries ——	3	17	-

1766	Wilson, Schoolmaster, Cr.	£.	s.	d.
July 7	By cash, in full ——	-	18	5
Dec. 1	By cash, in full ——	2	8	7
		3	7	-

1766	Ableman, Cr.	£.	s.	d.
Aug. 7	By sundries ——	15	17	6
	By account at fol. 1, ledger B	25	-	-

1766	Winton, Esq; Cr.	£.	s.	d.
Dec. 6	By sundries, in full ——	20	11	$0\frac{1}{2}$

1766	Slingstone, Cr.	£.	s.	d.
June 12	By a bank note ——	20	-	-
Nov. 28	By cash, in full ——	36	1	4
		56	1	4

1766	Watson, Cr.	£.	s.	d.
Dec. 10	By cash, in full ——	3	17	-

1766	*Dr.* *Sir Thomas*	£.	s.	d.
Apr. 7	To sundries ——	27	17	-
May 10	To sundries ——	8	12	$2\frac{1}{2}$
		36	9	$2\frac{1}{2}$

1766	*Dr.* *David*	£.	s.	d.
Apr. 24	To sundries ——	2	-	$8\frac{1}{2}$
May 20	To sundries ——	17	7	10
June 28	To sundries ——	34	12	$11\frac{1}{2}$
		54	1	6

1766	*Dr.* *Mr. Nicholas*	£.	s.	d.
May 14	To sundries ——	23	15	$4\frac{1}{2}$

1766	*Dr.* *Mrs.*	£.	s.	d.
May 26	To sundries —— ——	-	5	$5\frac{1}{2}$
Dec. 18	To $22\frac{3}{4}$ *lb.* sugar, at $8\frac{1}{2}$ *d.*	..	16	$1\frac{1}{4}$
		1	1	$6\frac{3}{4}$

1766	*Dr.* *Capt. James*	£.	s.	d.
June 3	To sundries ——	30	5	$5\frac{3}{4}$
July 28	To sundries ——	8	16	5
Nov. 15	To cash, in full ——	3	1	$10\frac{1}{4}$
		42	3	9

	Lawson, Cr.	£.	s.	d.
1766				
June 3	By a bill on Capt. James Dixon	10	-	-
Dec. 15	By 3*c.* 2*qr.* 14*lb.* tobacco, at 4*l.*	14	10	-
	By account at fol. 1, ledg. B	11	19	2½
		36	9	2½

	Johnson, Esq; Cr.			
1766				
Aug. 16	By cash, in part ——	50	-	-
Oct. 6	By cash, in full ——	4	1	6
		54	1	6

	Norton, of Durham, Cr.			
1766				
Sept. 9	By a bank note ——	20	-	-
	By account at fol. 1, ledg. B	3	15	4½
		23	15	4½

	Shields, Cr.			
1766				
Dec. 24	By cash, in full ——	1	1	6¾

	Dixon, Cr.			
1766				
Nov. 15	By 112½ ells of holland at 7*s.* 6*d.*	42	3	9

Dr.

		£.	s.	d.
1766	*Dr.* *Miss Fanny*			
July 3	To sundries ——	4	4	-
1766	*Dr.* *Mr. Roger Retail,*			
July 10	To sundries ——	83	5	9
1766	*Dr.* *Mr. Charles*			
July 17	To sundries ——	11	13	-
24	To sundries ——	12	4	2
Aug. 12	To sundries ——	5	10	6
		29	7	8
1766	*Dr.* *Mr. Conrade*			
Aug. 18	To sundries ——	56	19	5
1766	*Dr.* *Mr. John*			
Aug. 26	To sundries ——	16	7	-

		£.	s.	d.
1766	*Dawson, of Liverpool, Cr.*			
Dec. 22	By cash, in full ——	4	4	-

		£.	s.	d.
1766	*of Newcastle upon Tyne, Cr.*			
Dec. 24	By a bill —— ——	50	-	-
	By account at fol. 1. ledg. B	33	5	9
		83	5	9

		£.	s.	d.
1766	*Anderson, Cr.*			
Aug. 21	By 5 pockets of hops at 28*s*.	12	-	-
Sept. 24	By cash, in full ——	17	7	8
		29	7	8

		£.	s.	d.
	Compound, of Exeter, Cr.			
	By account at fol. 2, ledg. B	56	19	5

		£.	s.	d.
1766	*Baker, Cr.*			
Oct. 23	By cash, in part ——	10	-	-
	By account at fol. 2, ledg. B	6	7	-
		16	7	0

		£.	s.	d.
1766	*Dr. Mrs. March,*			
Sept. 3	To 8 ſarcenet hoods at 4*s*. 3*d*.	1	14	-
17	To 17 india fans at 3*s*. 10*d*.	3	5	2
29	To ſundries ———	8	6	3
Oct. 23	To ſundries ———	4	15	6
		18	-	11
1766	*Dr. Mr. Samuel*			
Oct. 2	To 14 *lb*. flax, at 1*s*. —	-	14	-
27	To ſundries ———	1	-	6
		1	14	6
	Dr. Mr. R. Barber,			
	To account at fol. 2, ledg. B	18	15	-
1766	*Dr. Lady*			
	To account from fol. 1 —	24	15	10
Oct. 6	To 27½ yds. holland, at 5*s*. 6*d*.	7	11	3
13	To 40 yds. iriſh cloth, at 3*s*. 4*d*.	6	13	4
		39	-	5
1766	*Dr. Mr. Matt. Milton,*			
Oct. 10	To ſundries ———	14	2	5

		£.	s.	d.
	of Chester, Cr.			
1766 Dec 6	By cash, in full ——	18	-	11
	Edwards, Cr.			
	By account at fol. 2, ledg. B	1	14	6
1766	*of Bristol, Cr.*			
Oct. 4	By 40 reams of foolscap, at 12*s.* 6*d.* —— ——	18	15	-
	Strawberry, Cr.			
1766 Oct. 25	By cash, in full ——	39	-	5
1766	*of Norwich, Cr.*			
Oct. 30	By sundries ——	12	2	5

Dr.

		£.	s.	d.
1766	*Dr.* *Mr. Henry*			
Oct. 15	To $2\frac{1}{2}$ *cwt.* iron, at 18*s.* 9*d.*	2	6	$10\frac{1}{2}$
	Dr. *Mrs. Mary*			
	To account at fol. 2, ledg. B.	9	8	6
1766	*Dr.* *Samuel*			
Nov. 7	To $32\frac{1}{2}$ *lb.* sugar, at $8\frac{1}{2}$ *d.*	1	3	$0\frac{1}{4}$
20	To $15\frac{1}{2}$ *lb.* currants, at 4 *d.*	-	5	2
29	To sundries ———	2	4	$10\frac{1}{4}$
		3	13	$0\frac{1}{2}$
1766	*Dr.* *Mr. Thomas*			
Nov. 22	To sundries —— ——	7	4	6
	To account at fol. 3, ledg. B	4	6	6
		11	11	-
1766	*Dr.* *Mr. Thomas*			
Dec. 8	To 3 chald. coals, at 1*l.* 15*s.*	5	5	-

	Forster, Cr.	£.	s.	d.
1766 Dec. 13	By cash, in full —	2	6	$10\frac{1}{2}$

	Gray, Cr.			
1766 Oct. 21	By 3 ps. irish cloth, qt. 87 yds. at 2*s.* 2*d.* — —	9	8	6

	Simpson, Esq; Cr.			
1766 Dec. 20	By cash, in full —	3	13	$0\frac{1}{2}$

	Grey, Cr.			
1766 Nov. 26	By 42 ells of holland, at 5*s.* 6*d.*	11	11	-

	Hunter, Cr.			
	By account at fol. 3, ledger B	5	5	-

		£.	s	d.
1766	*Dr. Peter Thompson,*			
Dec. 12	To 5 buts of oil ——	72	2	5¼

1766	*Dr. Mr. Edward*			
Dec. 23	To 3 *c.* 1 *qr.* cheese, at 30*s.*	4	17	6

	Dr. Mr. Joseph King,			
	To account at fol. 3, ledg. B	25	18	-

	Dr. Balance			
	To Mr. J. Elford, due to me,	3	4	10
	To Mr. Alderman Ableman	25	-	-
	To Sir Thomas Lawson	11	19	2½
	To Mr. Nicholas Norton	3	15	4½
	To Mr. Roger Retail	33	5	9
	To Mr. Conrade Compound	56	19	5
	To Mr. John Baker	6	7	-
	To Mr. Samuel Edwards	1	14	6
	To Mr. Thomas Hunter	5	5	-
	To Peter Thompson, Esq;	72	2	5¼
	To Mr. Edward Young	4	17	6
		224	11	0¼

	of Worcester, Esq; *Cr.*	£.	s.	d.
	By account at fol. 3, ledg. B	72	2	5¼

	Young, *Cr.*			
	By account at fol. 3, ledg. B	4	17	6

	of Windsor, *Cr.*			
1766 Dec. 30	By 18 qr. 4 bush. of wheat, at 1 *l.* 8 *s.* —	25	18	-

	Cr.			
	By Mr. R. Barber —	18	15	-
	By Mrs. Mary Gray —	9	8	6
	By Mr. Joseph King —	25	18	-
	By Mr Thomas Grey —	4	6	6
		58	8	-

LEDGER B.

The ALPHABET.

A *Alder. Ableman* 1	B *Mr. J. Baker* 2 *Mr. R. Barber* 2	C *Mr. C. Compound* 2
D	E *Mr. J. Elford* 1 *Mr. S. Edwards* 2	F
G *Mrs. M. Gray* 2 *Mr. T. Grey* 3	H *Mr. T. Hunter* 3	I
K *Mr. J. King* 3	L *Sir T. Lawson* 1	M
N *Mr. N. Norton* 1	O	P
Q	R *Mr. R. Retail* 1	S
T *P. Thompson, Esq;* 3	V	W
X	Y *Mr. E. Young* 3	Z

	Dr.	£.	s.	d.
	Mr. James			
1767	To account at fol. 1, ledger A	3	4	10

	Dr.	£.	s.	d.
	Mr. Alderman			
1767	To account at fol. 2, ledg. A	25	-	-

	Dr.	£.	s.	d.
	Sir Thomas			
1767	To account at fol. 3, ledg. A	11	19	$2\frac{1}{2}$

	Dr.	£.	s.	d.
	Mr. Nicholas			
1767	To account at fol. 3, ledg. A	3	15	$4\frac{1}{2}$

	Dr.	£.	s.	d.
	Mr. Roger Retail,			
1767	To account at fol. 4, ledg. A	33	5	9

Elford, of Bath, Cr.	£.	s.	d.
Ableman, Cr.			
Lawson, Cr.			
Norton, of Durham, Cr.			
of Newcastle upon Tyne, Cr.			

Dr.

	Dr. Mr. Conrade	£.	s.	d.
1767	To account at fol. 4, ledg. A	56	19	5

	Dr. Mr. John			
1767	To account at fol. 4, ledg. A	6	7	-

	Dr. Samuel			
1767	To account at fol. 5, ledg. A	1	14	6

	Dr. Mr. R. Barber,			

	Dr. Mrs. Mary			

	Compound, of Exeter, Cr.	£.	s.	d.
	Baker, Cr.			
	Edwards, Cr.			
	of Bristol, Cr.			
1767	By account at fol. 5, ledg. A	18	15	-
	Gray, Cr.			
1767	By account at fol. 6, ledg. A	9	8	6

	Dr. Mr. Thomas	£.	s.	d.
	Dr. Mr. Thomas			
1767	To account at fol. 6, ledg. A	5	5	-
	Dr. Peter Thompson,			
1767	To account at fol 7, ledg. A	72	2	$5\frac{1}{4}$
	Dr. Mr. Edward			
1767	To account at fol. 7, ledg. A	4	17	6
	Dr. Mr. Joseph King,			

	Grey, Cr.	£.	s.	d.
1767	By account at fol. 6, ledg. A	4	6	6

	Hunter, Cr.			

	of Worcester, Esq; Cr.			

	Young, Cr.			

	of Windsor, Cr.			
1767	By account at fol. 7, ledg. A	25	18	-

THE END.

E R R A T A.

The *Anſ.* to queſt. 4, pag. 54, muſt be $4\frac{92}{437}$.
Anſ. to queſt. 6, pag. 144, ought to be 390270.

THE EXPERIENCED
Engliſh Houſekeeper,

FOR THE USE AND EASE OF

Ladies, Houſekeepers, Cooks, &c.

Written purely from PRACTICE,

DEDICATED TO THE

Hon. Lady ELIZABETH WARBURTON,

Whom the Author lately ſerved as Houſekeeper:

Conſiſting of ſeveral Hundred Original Receipts, moſt of which never appeared in Print.

PART I. Lemon Pickle, Browning for all Sorts of Made Diſhes, Soups, Fiſh, Plain Meat, Game, Made Diſhes both hot and cold, Pies, Puddings, &c.

PART II. All Kinds of Confectionary, particularly the Gold and Silver Web for covering of Sweetmeats, and a Deſert of Spun Sugar, with Directions to ſet out a Table in the moſt elegant Manner and in the modern Taſte, Floating Iſlands, Fiſh-Ponds, Tranſparent Puddings, Trifles, Whips, &c.

PART III. Pickling, Potting, and Collaring, Wines, Vinegars, Catchups, Diſtilling, with two moſt valuable Receipts, one for refining Malt-Liquors, the other for curing Acid Wines, and a correct Liſt of every Thing in Seaſon for every Month in the Year.

By ELIZABETH RAFFALD.

A NEW EDITION,

In which are inſerted ſome celebrated Receipts by other Modern Authors.

LONDON:

PRINTED FOR THE BOOKSELLERS.

MDCCLXXXIX.

TO THE HONOURABLE

LADY ELIZABETH WARBURTON.

PERMIT me, honoured Madam, to lay before you a work, for which I am ambitious of obtaining your Ladyſhip's approbation, as much as to oblige a great number of my friends, who are well acquainted with the practice I have had in the Art of Cookery, ever ſince I left your Ladyſhip's family, and have often ſolicited me to publiſh for the inſtruction of their houſekeepers.

As I flatter myſelf I had the happineſs of giving ſatisfaction, during my ſervice, Madam, in your family, it would be a ſtill greater encouragement, ſhould my endeavours, for the ſervice of the ſex, be honoured with the favourable opinion of ſo good a judge of propriety and elegance as your Ladyſhip.

I am not vain enough to propoſe adding any thing to the Experienced

 Houſe-

Houſekeeper, but hope theſe receipts (written purely from practice) may be of uſe to young perſons who are willing to improve themſelves.

I rely on your Ladyſhip's candour, and whatever Ladies favour this book with reading it, to excuſe the plainneſs of the ſtile; as, in compliance with the deſire of my friends, I have ſtudied to expreſs myſelf ſo as to be underſtood by the meaneſt capacity, and think myſelf happy in being allowed the honour of ſubſcribing,

MADAM,

Your Ladyſhip's

Moſt dutiful,

Moſt obedient,

And moſt humble Servant,

ELIZABETH RAFFALD.

Preface to the Firſt Edition.

WHEN I reflect upon the number of books already in print upon this ſubject, and with what contempt they are read, I cannot but be apprehenſive that this may meet the ſame fate with ſome, who will cenſure before they either ſee it or try its value.

Therefore the only favour I have to beg of the public is, not to cenſure my work before they have made trial of ſome one receipt, which I am perſuaded, if carefully followed, will anſwer their expectations; as I can faithfully aſſure my friends, that they are truly written from my own experience, and not borrowed from any other author, nor gloſſed over with hard names, or words of high ſtile, but written in my own plain language, and every ſheet carefully peruſed as it came from the preſs, having an opportunity of having it printed by a neighbour, whom I can rely on doing it the ſtricteſt juſtice, without the leaſt alteration.

The whole work being now completed to my wiſhes, I think it my duty to render my moſt ſincere and grateful thanks to my moſt noble and worthy friends, who have already ſhewn their good opinion of my endeavours to ſerve my ſex, by raiſing me ſo large a ſubſcription, which far exceeds my expectations. I have not only been honoured by having above eight hundred of their names inſerted in my ſubſcription, but alſo have had all their intereſt in this laborious undertaking, which I have at laſt arrived to the happineſs of completing, though at the

the expence of my health, by being too ſtudious, and giving too cloſe application.

The only anxious wiſh I have left is, that my worthy friends may find it uſeful in their families, and be an inſtructor to the young and ignorant, as it has been my chiefeſt care to write in as plain a ſtile as poſſible, ſo as to be underſtood by the weakeſt capacity.

I am not afraid of being called extravagant, if my reader does not think that I have erred on the frugal hand.

I have made it my ſtudy to pleaſe both the eye and the palate, without uſing pernicious things for the ſake of beauty.

And though I have given ſome of my diſhes French names, as they are only known by thoſe names, yet they will not be found very expenſive, nor add compoſitious but as plain as the nature of the diſh will admit of.

The receipts for the confectionary are ſuch as I daily ſee in my own ſhop, which any Lady may examine at pleaſure, as I ſtill continue my beſt endeavours to give ſatisfaction to all who are pleaſed to favour me with their cuſtom.

It may be neceſſary to inform my readers, that I have ſpent fifteen years in great and worthy families, in the capacity of a Houſekeeper, and had an opportunity of travelling with them; but finding the common ſervants generally ſo ignorant in dreſſing meat, and a good cook ſo hard to be met with, put me upon ſtudying the Art of Cookery more than perhaps

I other-

I otherwiſe ſhould have done; always endeavouring to join œconomy with neatneſs and elegance, being ſenſible what valuable qualifications theſe are in a houſekeeper or cook; for of what uſe is their ſkill, if they put their maſter or lady to an immoderate expence in dreſſing a dinner for a ſmall company, when at the ſame time a prudent manager would have dreſſed twice the number of diſhes for a much greater company, at half the coſt?

I have given no directions of cullis, as I have found, by experience, that lemon pickle and browning anſwers both for beauty and taſte (at a trifling expence) better than cullis, which is extravagant; for had I known the uſe and value of thoſe two receipts when I firſt took upon me the part and duty of a houſekeeper, it would have ſaved me a great deal of trouble in making gravy, and thoſe I ſerved a deal of expence.

The number of receipts in this book are not ſo numerous as in ſome others, but they are what will be found uſeful and ſufficient for any Gentleman's family——neither have I meddled with phyſical receipts, leaving them to the phyſicians' ſuperior judgement, whoſe proper province they are.

Description of the PLATE.

THE Plate is the design of three stove-fires for the kitchen, that will burn coals or embers instead of charcoal, (which I always found expensive as well as pernicious to the cooks) and will carry off the smoke of the coals and steam, and smell of the pots and stew-pans; the coals are burnt in cast iron pots, flat at the bottom, with bars.

AA, Fronts of the stove.

BB, Top of the stove, which is covered all over with cast iron.

CC, Stove-pots, in which the fire is made.

D, The form of the pot, with two vents cast in them, six inches deep at the top, and three wide, as expressed at HH in the pot, and to let the smoke through at H's in the flues.

EE, Carried from the fire through the back wall to the kitchen chimney, as expressed in the lower plan.

FF, Back wall.

G, The chimney-breast, betwixt which and the back wall the steam rises, and goes off into the kitchen chimney by a vent made into it.

HH, Vents in the pot.

II, Draughts for the fires, and to receive the ashes.

The scale will give the dimensions.